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NOTES AND COMMENTS.

Badly Equipped Foundries.

To those who are familiar with the high development and scientific accuracy of engineering plant and works equipment, probably the most striking feature of the foundry to-day (excepting certain really modern foundries) is the crudity of the plant and equipment provided for important operations. It would be idle to contend that the development of foundry methods and appliances has been anything like in keeping with the advances recorded in most other branches of engineering; for though the demands made on that department are year by year becoming more exacting, the assistance accorded the foundryman in meeting those demands is most meagre. Not that the standard of the foundry's product has not been raised; for it is well known that really creditable advances have been made. But these advances have been largely the result of direct personal effort and individual attention to the material and its phenomenon. The result is that while the standard of the foundry's product is raised to meet the demands placed upon it, the foundry itself has not become a much more economical productive unit than it was a couple of generations ago. There is still a huge waste of energy and time allowed continually; and instead of the engineer's increasingly severe demands being met by corresponding facilities for production, the old facilities have to be relied upon and the difference made up by excess of individual effort on the part of the guiding intelligences of the foundry. What that same effort would produce, given increased facilities, it is difficult to say, for the chance so rarely occurs.

There is little doubt that the foundry in the past partly earned its bad reputation in the engineering world by the crudity of its operations and the uncertainty of its products. Now that this uncertainty has largely been minimised by bringing greater intelligence to bear on the operations, is it not time that facilities were generally accorded for carrying out the operations themselves on better lines? The proprietor of a works, however, would usually far rather see £100 spent on a new machine tool for the fitting shop than £50 spent on equipment for the foundry, though the latter would frequently give the better return. It is hardly an exaggeration to state that nearly half of the foundries in England to-day, if pulled down, rebuilt and properly equipped, would not only pay a good interest on the capital thus sunk, but would also give a much better return on the business as such. The trouble frequently starts with the building itself being quite unsuitable, inconvenient, and incommodious. Every available corner is crowded with material, and no operation can be conducted with facility. The disposition of the different work, too, is wrong, necessitating much waste of time and unnecessary handling and moving of material; and added to this is the trouble of bad or insufficient equipment for this handling. It is in one sense rather unfortunate that the personal factor enters so

largely into the success of foundry work, for this has led proprietors to think everything in that department can be adequately met by the personal factor. True it may be and is generally so met, but at much waste of time and energy. But it is difficult to establish the conception that foundry economy consists of more than saving a few shillings a ton on pig-iron, coke and sand.

In considering the foundry from a commercial standpoint, the first essential is to enquire whether the building, equipment and general facilities are such as to allow the greatest efficiency on the part of the men. This means that, first, abnormally uncomfortable working conditions must be altered; good ventilation, lighting and sanitary convenience must be provided, and all conditions which tend to degrade the self-respect of the workers must, where possible, be changed. This does not mean that the moulder's must be a "gentleman's job;" it simply means that what has been realised in other departments should be applied in the foundry also. On the question of lighting alone much could be said in this direction. On another page we publish a most instructive abstract from the Report of the Chief Inspector of Factories and Workshops, in which the lighting of iron foundries is discussed. It is noteworthy, too, that in those foundries where bad artificial lighting is found, the expense of the bad system is greater than a thoroughly efficient modern system, involving the double waste of greater outlay and decreased efficiency in workmanship. Not often is it sufficiently realised that the rate of a worker's operation as well as the quality of the work is greatly effected by the efficiency of the illumination provided, though we have known cases where a clear 10 per cent. increase in workers' efficiency was obtained by substituting adequate for poor lighting, and this with only a trivial outlay and no permanent increase in cost. It cannot be too often emphasised, in this connection, that bad artificial lighting does not necessarily represent cheapness in cost, and that the most efficient often involves no more regular expenditure than old, inadequate systems.

On crane equipment and mechanism for handling materials, much might be said to the same effect. The obvious waste involved in the employment of skilled men's time and energy for handling heavy weights and performing simple laborious tasks is frequently ignored—when it occurs in the foundry; though why this should be the case it is hard to say. Considerable intelligence, of course, is necessary in equipping a foundry with such appliances, or they may be more nuisance than help; and in this probably lies the explanation for the present condition of things. As regards moulding machines, by the correct application of which very considerable economies can often be secured, the opposition of the moulder himself has been the great hindrance to progress. Efficient machines have many times been condemned as useless before being given a fair trial; and to-day there are to be found in different foundries expensive apparatus standing idle in odd corners, monuments not to the inapplicability of machinery for moulder's work but to the shortsightedness of the moulder. This, of course, does not apply in every case, for unsuitable machines have in some instances been installed; but too frequently the cause has been as indicated.

Turning to the cupola and its accessories, here again obsolete plant is quite common. Designs that under old, slow conditions have proved fairly satisfactory are still retained, despite the much higher efficiency of modern designs. Blowing apparatus totally unsuited to the work and consuming an excess of power in operation are to be seen working in foundries attached to engineering works where only the most modern of machines are allowed in other departments. The preparation of moulding sand, also, is in most foundries quite inadequately provided for; though in this matter the moulder himself seldom sufficiently understands what is necessary even if he had the choice of plant. So he goes daily through the laborious and hopelessly inefficient processes that have been practised for years, changing his sand if he gets into too much trouble with it, and generally making the best of a bad job.

The pattern-maker's shop, being a foundry department, is similarly neglected in the matter of proper equipment, though its efficiency also might frequently be much increased at little cost. We have previously commented on the deplorable equipment that is provided in the pattern shops of some big works. At the moment we need only say that could the waste thus incurred be properly represented in the right quarter in such cases, the fact would come as a shock to those in control. But complaints from the foundry and the pattern-shop alike are too apt to receive scant consideration.

This is not a subject only for those who are interested in the conditions under which foundry operatives have to conduct their work; it is a matter of hard business economy—a matter of profit and loss to the proprietors of foundries. Therefore, the sooner the facts are realised the better it will be for all those concerned. But there are already marked signs of a change in the attitude of the engineering fraternity towards the foundry and its workers, and in the near future we look for a distinct movement towards realising those great economies in foundry working that are undoubtedly to be accomplished

British Foundrymen's Association.

London Branch.—At a general meeting of this Branch, last month, the following officers and Council for the year 1913-14 were elected:—President, J. Ellis (Luton); Vice-President, R. Woods (London); Hon. Secretary, T. Murphy, 180, Gray's Inn Road, London, E.C. Members of Council:—C. T. Aston (London), H. O. Beere (London), A. Barber (Romford), A. R. Bartlett (Erith), G. H. Barrett (Luton), E. A. Chell (London), W. Ellis (London), D. Gordon (London), T. F. Hardyman (Yeovil), G. B. Henderson (Southampton), J. W. Horne (Past-President of Branch, London), A. Hayes (London), J. Oswald (Past-President of Branch, London), B. F. Sperring (Portsmouth), A. Willis (London), and J. W. Worrall (Luton). The meetings will be held at the Northampton Institute, St. John Street Clerkenwell, E.C.

Newcastle-on-Tyne District Branch.—The following officers for the year 1913-14 were elected at the annual meeting of this Branch of the Association:—President, R. Wallis (Wallsend); Vice-President, J. Weir (South Shields); Hon. Secretary, H. A. J. Rang, Edwalton House, Cleveland Road, North Shields. Members of Council:—Messrs. J. C. Carmichael (South Shields), J. W. Paulin (Walkergate), J. C. Horsley (North Shields), J. J. Collin (Sunderland), A. Morris (Sunderland), H. Ford (Gateshead), J. Mathews (Wallsend), W. Henderson (Heaton), J. W. Newton (Darlington), J. Smith (South Shields), E. Smith (South Shields), R. R. Denton (Blaydon), M. E. Gallon (Dunston), and T. G. Jones (Middlesbrough).

British Foundrymen's Association.

Discussions at the London Convention.

(*Continued from page* 424.)

Semi-Steel.

Owing to the extent of the discussion on this Paper by Mr. M. Riddell (see page 440 of our last issue) members were requested to send their further contributions in writing.

Mr. Alexander Hayes wrote :—It is interesting to note that Mr. Riddell, like others before him, admits candidly that there is little reduction in the total carbon in the final iron by reason of steel additions; though he scarcely goes far enough in this respect. Too frequently it has been loosely assumed that an excessive temperature was necessary to melt the steel, but that when once melted it had a beneficial result by reason of the reduction in total

Mr. J. Ellis; Junior Vice-President of British Foundrymen's Association.

carbon. In short, the vague idea that the steel properties were being conferred upon cast iron was commonly held. A moment's careful thought on the subject should dismiss this belief, for it is well known that low-carbon steel melting temperatures are not attained in the cupola. At the same time it must not be supposed that the theory of carbon absorption is by any means new. Discussing the subject with a user of semi-steel nearly two years ago, I suggested that carbon absorption during melting was an inevitable feature of the process, and that the maximum was reached at the saturation point of carbon for iron at the temperature of the particular cupola. This was accepted by the user in question as being already understood. As has previously been stated in the Foundry Trade Journal, the process is much on the lines of a rapid cementing action—much more rapid, of course, than in ordinary cementation, by reason of the much higher temperature in the cupola, but nevertheless analogous. It would be well, then, to avoid any misconstruction, were the author to alter the paragraph in which he states "the theory which the writer offers," making it instead, "the theory the writer *supports*," etc. Without in the slightest discounting Mr. Riddell's work on the subject, it will be acknowledged that the theory which he treats is by no means new. On some points, however, I find myself rather at conflict with Mr. Riddell. I cannot follow his calculations based on the equilibrium diagram. He seems to have confused the question of freezing temperature with the capacity of pure molten iron to absorb carbon. The *liquidus* curve of the equilibrium diagram does not by any means indicate the amount of carbon that will be taken up by the metal; it simply shows the points at which the various alloys of carbon and iron commence to solidify. The saturation point at any temperature must not be confused with the *liquidus*. On the basis of Mr. Riddell's reasoning, given a sufficiently high temperature the metal should absorb practically no carbon. This, of course, is not in keeping with known facts; for the higher the temperature the greater the carbon content or saturation. This is admitted by Mr. Riddell in his reference to cold-blast irons; and he also remarks that the carbon absorption continues after melting. But he disregards this in his calculations. Another contention which Mr. Riddell puts forward with which I find myself in conflict is on the matter of hard spots. I cannot help admiring the ingenious explanation, according to which spots of high-carbon steel are retained as such; but I think it is hardly likely that they result from unmelted steel falling into the metal. Even were a piece of steel to fall as described and absorb carbon, it must be remembered that it has to undergo two pouring processes at least before it enters the mould, and it is extremely unlikely that it would retain its identity as a spot. It is far more likely that it would be drawn out in the pouring process as a streak or, at any rate, be considerably intermingled with its surrounding metal. In pouring fluids there is a movement throughout the entire mass which does not allow areas of a distinct nature to retain their shape and position in the general mass. If these hard spots occurred as streaks Mr. Riddell's explanation would find greater support. That Mr. Riddell is somewhat incorrect in his assumption is borne out by the fact that some experimenters have found it impossible to produce hard spots in a casting by throwing portions of steel into the ladle and pouring without stirring. Also, the same ladle of metal or "semi-steel" will pour castings entirely devoid of the defects in question for the first part, while if the last of the metal is used for another mould, and has, of course, somewhat cooled, that latter casting will in all probability be full of cold shot. I should like to know whether Mr. Riddell has made accurate analysis of these spots. It is, of course, very easy to produce hard carbon-iron spots in small experimental masses, where a slight chilling action will readily retain

the carbon in the combined form; but even with a low-silicon iron-carbon alloy, when surrounded by a mass of hot metal and slowly cooled, the same effect is not got. Personally, I am inclined to think the explanation lies in the fact that an iron with a high proportion of steel which has absorbed carbon in the cupola, has a proportion of its carbon in a condition very susceptible to chilling effects, and if this metal cools too much before the final mixing caused by pouring, it does not form a homogeneous mixture with the other metal, but exists as hard *areas*. This assumes that molten iron with steel additions does not in any case properly mix by simply dropping down as molten metal in the cupola, whatever the temperature, and only becomes properly mixed if poured finally at a high temperature. Even then it may not mix thoroughly though the slow cooling in the mould would prevent the chilling effect. This would appear to be borne out by the fact that semi-steel poured rather cold is so extremely liable to cold shot. Of course, irregularity through imperfect mixing is involved in this; but it does not appear necessary to presume portions of steel not melted in the cupola. On the question of the melting, a point which Mr. Riddell does not stress is that while the carbon absorption and melting of the steel is from a surface action, it is nevertheless very rapid. As a matter of fact, I have known cases where it was quite common for the steel to thus melt before a more refractory pig, say a very open No. 2. The explanation for this is that the large flaked graphite in No. 2 iron, while being very refractory, prevents by its presence the absorption of further carbon such as rapidly goes into the steel. At the same time the refractory graphite in the No. 2 iron requires the metal to be brought up to a higher temperature for melting than is required for the carbon absorption by the steel. Also, I think it is highly improbable that the larger graphite is totally dissolved in melting, but that rather the nuclei are not destroyed but are retained in suspension and hasten the formation of graphite flakes in cooling. This is quite in keeping with the well-known phenomenon of crystallisation, in which the perfect dissolution of crystals it someimes difficult. Since the carbon absorbed by the steel is at no time of this crystalline nature, it is not so readily deposited as large graphite during cooling; hence the close fine texture which characterises semi-steel and hence also the liability to detrimental effects from chilling on pouring below proper heat. The whole subject requires reconsideration, and the experience of other users on a more extended scale should be considered before definite conclusions are formed.

Standard Patterns for Motor Work.

A MEMBER said that it seemed to him a pattern half metal and half wood would cost practically the same as one of metal altogether. It would be practically as cheap to have one made in soft wood and make an iron pattern from it, and this would extend the life of the pattern almost indefinitely. He had often found that placing iron and wood together was not altogether a very good practice, inasmuch as it was not an easy matter to secure them together in such a way as would make the drawing easy and regular. Some people had the practice of placing at the top of the pattern a brass strip to prevent the moulder, when he was pushing down his vent wires, stripping off the outer edges, but it was found that they got bad draws because of these strips being pushed into the sand by the operation of the vent wires. It might be that blowholes were sometimes caused in venting. The plate had not the same expansion as the wood, and therefore he thought that in many cases at least it would be better to make at once a metal pattern.

MR. GALLON thought that even the moulder could tell the patternmaker sometimes how to put in a screw. In the old days the patternmakers used to put tallow on their screws, but in these days they not only put no tallow on, but got the longest lever brace they possibly could, so that the screw was as if it had been put in by machinery instead of by the hand of man. Now the hand of man had got to take some of those screws out and he wanted to know why it was that the patternmaker allowed his man to put the screws in with a brace when they had got to be brought out by hand.

MR. MAYER said he must admit that he had got a lot of consolation from Mr. Worrall's Paper. He had been thinking for some time that pattern-making was a lost art. (Laughter). His friends could speak feelingly, no doubt. Engaged as he was in all sorts of modern engineering work, he knew that those excuses for patterns they got were something appalling. Mr. Gallon talked about screws, but there were often no screws; it was nails that were driven in, and the difficulty experienced in getting some of these patterns out was beyond description. He would not object to some of the patterns being made of cheap wood when the castings were to be got out cheaply, but one would think they had got very cheap work indeed sometimes, and that they forgot altogether about the drawing. The crudeness of pattern-making was certainly a growing evil. As showing the importance of good pattern making, he might mention a Gateshead firm who were the greatest winch makers in Britain, and their great success was achieved by the doggedness of the foreman moulder. Nearly everything they put into the machines, even the cylinders and drums and other things which went to make up the winch, were made in the foundry, and that was because the foreman moulder had induced the directors to issue instructions that when a designer or draughtsman made drawings for a winch he must consult the foreman moulder, and if he was told to take a nice corner off here and there, and reduce these very costly ornaments, he had to do so. It was by that means that the firm had become what it now was.

MR. F. W. FINCH (Gloucester) thought that employers had been much to blame for the falling off among pattern-makers. Employers did not realise that it was more costly to have bad patterns than to have good ones. In the foundry of which he was manager, they had an axle-box pattern made entirely of wood—mahogany. They had made over 4,000 castings from it, and only very slight repairs had been necessary; and he had no doubt that for a couple of pounds they could make that pattern serve for another 4,000 castings. Employers did not allow sufficient money to be spent on patterns; it was all a matter of rush to make everything as cheaply as possible.

MR. NICHOLSON (Dartford) said that designers came to him occasionally, and asked how he would prefer to have a design drawn to facilitate the foundry work. He usually said: "Do you know what you want?" and when they said "Yes," he said, "Then draw it and I will make it." The pattern-maker and the moulder should not interfere with the designer if a competent designer had been engaged, but of course, the designer should not draw impossibilities. With regard to the quality of patterns in the North of England, what was done at motor works showed that pattern-making had not gone back but had gone forward very considerably. When a man could take a

set of drawings, perhaps of four cylinders in one casting, and carry out the job successfully, or make the patterns of gear boxes, and make them perfectly, so as to get good castings, he was not only a pattern-maker—he was an artist. Very often the patterns were only 5 mm. thick, and in some cases they were less than that; and it the moulding of the water jacket on the cylinder, and all the different problems involved in motor car work were considered, he thought it would be admitted that pattern-making had made a great advance on what was done thirty years ago. As one who had worked on the first motor-car patterns made in England, all his experience showed that pattern-making had not deteriorated, but the reverse. Anyone who went into a motor shop and saw the gear boxes, crank cases, and other intricate castings, would be inclined to agree with him that no branch of engineering had made a greater advance.

Mr. J. Smith said that for a considerable time he had had experience in working off patterns made for marine castings, and he must say it had been a varied experience. He had always found that the best pattern was very much the cheapest in the end. Twenty-five years ago he worked as a journeyman in Sunderland, and there he worked up a set of marine-engine patterns, including a condenser, bedplates and cylinder, and about three months ago he had the pleasure of making in his present foundry, a set of castings off those very patterns, though they had been constantly in use all that time. This was simply through the pattern being built strongly in the first place, well stayed and well tapered. About six months ago, he had made, for another firm, a set of patterns for a patent, the design being on a very large scale. At first they found it most difficult to remove the patterns of the intermediate cylinder and had to use crowbars. That really meant that the patterns were not sufficiently stayed in the centre to withstand the pressure of the loam, and not sufficiently tapered to enable them to be withdrawn. The stronger the pattern was the better, and if there was sufficiet taper to draw, but not too much, then the withdrawal after the first start was quite easy. Such a pattern was much cheaper to the employer than an ill-made and squarely built one. Pattern-makers were apt to blame employers for wanting cheap work, but if the foreman pattern-maker would explain that the stronger the pattern was the cheaper it was in the end, he believed that they would get what they wanted. He recalled the time when turbine castings commenced to be made for the larger ships and the engines made for the "Virginia" were the first turbines put into the shops. The patterns were good, sound, solid, block patterns, and no moulder could get wrong in making a casting off them. The turbines had developed since that day, but the pattern was being made upon the old block. Employers should understand the great saving of labour that ensued from having good patterns, and that in many jobs the wages of men and boys might cost him £1 a ton more through having patterns made in the cheapest way.

The President said that it appeared to him from the remarks that had been made that there must be very funny managers in some foundries. (Hear, hear.) He had had the job a good many times of calculating out the cost of pattern-making and the cost of moulding, and he used to conclude that if he wanted a large number of castings he wanted a good pattern, but where only one or two or three castings were required, it would not do to spend so much upon the pattern. The pattern-maker was often ready to do good work, but it was sometimes difficult to get him to do the somewhat cheap work that sufficed when only one casting was wanted.

Mr. Worrall, in his reply, referred first to the President's remarks, and said that he always made it a rule to give three prices for the pattern, one for the experimental pattern, then one for the pattern for a small quantity, and a third for the standard pattern. He had made the patterns so rough when he had been asked to quote a low price that the men had sworn at them. Coming to the question of making patterns partly of metal and partly of wood, his idea was that in making patterns on that system the cost was reduced. It did not always pay to make a complete metal pattern. Any part that was likely to get a knock he made of metal, and in the particular class of work he was dealing with he found that on his system the job could be proceeded with very rapidly. He had weighed it up very carefully, and he found that his system saved a great deal of money in the long run, and made a good creditable job. With regard to screws, that was partly the foreman pattern-maker's fault. He himself always saw that his men were supplied with a tallow pot, and he always told them to use it before putting in any screw. A foreman pattern-maker had to be very observant, and to see after those things himself. A man would not take any notice of the draughtsman. If a man got hold of efficient tools he did efficient work. With regard to draughtsmen and moulders, he did not see why the draughtsmen and moulders should not confer together, and the moulder and the pattern-maker. He made it a practice to spend a certain amount of time in the drawing-office, and if he saw any design that was likely to give trouble he simply said, "If you can manage to move this or that into a different position it will be an advantage to us." He only wished the moulders would endeavour to come to their assistance in persuading managers to avoid cheap pattern-making. They had to show the managers that it paid to get an article which was sound, and that if moulds were made off a bad pattern the loss would be greater than the saving. If the matter were properly put before the manager he would recognise that the best pattern was the best for him in every way.

Economics of Industry and Education.

The President (Mr. S. A. Gimson) observed that as he only obtained the Paper a few days before the meeting he had not been able to read it carefully; but so far it appeared to embody the ideas he himself had been trying to express in his Presidential Address; in fact, Mr. Hayes might think he had been "cribbing" if that address had not been written and in type before he saw the Paper.

Mr. Buchanan remarked that their principal difficulty was the vastness of the question. (Hear, hear.) There were so many facets of the matter that it was difficult to know which one to examine most closely. However, there would, he thought, be general agreement with Mr. Hayes in regard to the ideal he had formulated regarding education and the future of the race. They were apt to measure things by money values and to place too much importance on material things—on what a man had, not on what he was. (Hear, hear.) He was glad to hear Mr. Hayes' remarks on the development of the public conscience. There were things beyond money values, and things outside mere work. Nothing so lightened labour or so fitted one for work as some ideal which lay beyond the work itself. As one who was perhaps engaged in the higher walks of a working life, he sometimes thought how difficult it must be, say, for the man who worked with the pick and shovel on

the road to get along, and wondered how, to use a colloquialism, he "bucked up" to it daily. He must have some pressure on him, probably poverty. But there was a pressure even higher and stronger. That was the ideal they ought to have before them to live a full life. The Association was concerning itself about the future of the industry as related to the young generation whom they saw and desired to see carrying on the work in the future to an even greater degree of perfection than they themselves were doing to-day. There was no doubt whatever that Mr. Hayes' contribution would help to crystallise their views and assist them in making recommendations as to the direction in which the work of training the juniors should be carried on. In confirmation of what Mr. Hayes had been saying, he asked their permission to read a few words written in the report of the British Science Guild, of which Sir William Mather was President. Sir William Mather was a great engineer in Lancashire, and he had taken for many years a very live interest in education; he stipulated that his apprentices should put in so many hours a week at the technical school, and seemed to have had a difficulty in getting them to agree to that condition and to carry it through. Sir W. Mather, in the Report, said, "When education can be considered as a science having to do with the growth and development of the body as well as of the mind and soul, it will be possible to base a system of education on the laws that govern the right growth and expansion of the physical, intellectual, moral and artistic qualities inherent in human nature." Mr. Hayes practically told them the same things, and was putting the same ideals before them. It was a healthy sign when they saw such expressions from different people. Then Sir W. Mather went on to speak, just as Mr .Hayes had done, of the necessity of reforming their elementary schools so that the boys trained in them might be more fitted to take up easily and rapidly the further education which they must necessarily undergo before they could be fully fitted for their future work in the world. His own remarks, perhaps, were rather nebulous, but were in some degree an expression of the hazy views they had as a whole. If they all considered the matter they would, no doubt, fix on a promising scheme which would help forward the industry with which they were connected. (Applause.)

Mr. Gordon said that when he read through the Paper it seemed to him that Mr. Hayes was developing a scheme more or less Utopian, and when one woke up it was rather a shock. He would be glad if Mr. Hayes would explain what he really meant. To take the system outlined he would imagine that a negro in Central Africa with a crowd of kiddies, and who, owing to his environment, had a brain more or less reactionary, had attained an ideal state; because, as Mr. Hayes put it, he had not the question of the maintenance of the children. He (the speaker) did not see how one could possibly formulate an ideal for the community. Ideals were more or less individual: fifty men had fifty different ideals. He could imagine a moulder's ideal as a "rasher and egg" every morning, starting work at ten and leaving off at four. That would be the ideal state for the average moulder. On the other hand, another man would consider liberty and plenty of books as ideal and so we should get various stages of the ideal system. Mr. Hayes had lain down certain lines which a scheme of elementary education should follow. The present elementary education system was very much abused. Owing to the abusive way in which it was treated, the teachers themselves had a lot put on their shoulders which they really were not capable of doing. Elementary education ought to be a solid understanding of the three R's. (Hear, hear.) Nowadays they found that the education given was very superficial—a little botany, a little physiology, a little art; in fact, a little of almost everything. Let him give an example. How many in that room could add up a simple fraction sum? (Laughter.) They were far better qualified to chase "X" all over a sheet of paper than to do an ordinary elementary mensuration sum. He was rather in agreement with Mr. Hayes as regarded college-trained men who "swatted up" for a certain thing. If a man wanted any degree, and was willing to pay ten guineas to the Tutorial Press, it was quite easy for him to get it. They told him to learn certain things because he was sure to be asked questions about them, and if he studied them he could get through all right. That kind of education had no solidity about it. Dealing with the technical schools as they found them, these should be vocational schools. Many boys were pitched into trades or professions for which they were totally unfitted. A moulder, for instance, very often did not wish to put his son to his own trade: he would rather see him a draughtsman or perhaps a pattern-maker, because those jobs were a bit cleaner than his own. The boy then went in for a trade for which he was totally unfit. A trade school should be a school where a boy could go and see classes working at all those trades, and that at which he did best should be his vocation in life. (Hear, hear.) A man who was going to put his energies to becoming an artist in metals ought to devote the whole of his time to that. Surely he had enough there for his life's work. But what did they find? An instructor in Art would attempt to teach anything from designing a cathedral to a piece of wallpaper. They must get solidity into education before they could do any good. Mr. Hayes had referred to an examination scheme. The every-day competitive examination was the biggest farce in the world. A boy entered for an examination, and very probably passed, and they found that after a short time his growth was quite stunted. He came into contact with a good many boys who had won competitions under the London County Council, and wondered how on earth they ever got through; they seemed to have been lucky, for it could not be put down to anything else. To his mind the system of examination questions was entirely wrong. For instance, if a man was going to pass his life chiefly using his hands instead of his brains, why should he be made to answer a lot of questions in mathematics? As a matter of fact, more marks were always given for a mathematical problem than for some hand work. A student might have most excellent craftsmanship, but fail lamentably in mathematics, and consequently did not get the opportunity of going further with his education. Why should they damn the boy because he could not pass in mathematics? That was the kind of thing they got all round. He congratulated Mr. Hayes on his Paper, though there were some points on which they did not agree.

Mr. T. Swinden (Sheffield) said that he could not let the remarks concerning technical training pass by unchallenged. It was all very well to run down the trained men, because in some cases the trained man was not exactly what one would desire. The Association had formed a special committee to investigate the question and, if possible, formulate some lines to give some advice to educational bodies in great cities to help along the work in the foundry industry. In regard to teaching by correspondence, it was all very well to say that they had a man told to learn a certain thing because he was to be asked a question on that, but the questions were put to test a man's knowledge. He thought that the training as a whole given in the modern university, was distinctly good and not quite so dull and so super-

ficial as one might be led to expect. He took it that Mr. Hayes' Paper was a sort of sequel to the Paper given last year by Mr. Horne, when points were raised as to the economic side, and his mind was in a somewhat disturbed state because he had always taken it that that training was to make a man more interested in his work and enable him to get more pleasure from it (hear, hear), and so that the work would be of bigger benefit both to him and to his employers. He had been told that morning that they were to look to something quite beyond that, and to look upon the daily work as something to be got over. They must not think that he did not believe in the higher ideal, but he thought they must look to the lower ideal first. He thought if they could arrive at some system of getting apprentices and the younger men to take more interest in their work and to enable them to appreciate the intricacies of their daily work, it would be to the advantage of the men in every respect, and would be a step towards that higher ideal that Mr. Hayes had put forward. He thanked Mr. Hayes for his Paper which would help the Special Committee very much.

Mr. Fox Allin remarked that the subject of Mr. Hayes' Paper was first, last, and all the time a social one. It was very obvious that they could not take a man's mind and leave his body to rot. In all questions of reform, they must start at the bottom of the ladder and not at the top and struggle downwards. They knew that the moulder's ideal existed, but to uplift that ideal they must take the man to a better social standard, in other words give him an interest in acquiring knowledge. The evolution would be very gradual but there was no doubt it would come. With regard to technical education, he thought that though they might make a practical man a theoretical man, they would never make a theoretical man a practical one. He did not disparage university education. While universities no doubt turned out good men, the shops turned out good men too. In his experience of the shops the men who had turned out best were those who came into the shops from school. He found that the man who came with a university training had an idea of a high collar and a pair of kid gloves, and was more or less eaten up with an exaggerated idea of his own importance, and was almost able to run the shop after being there a fortnight (laughter). Of the premium apprentices who came to learn the business not 10 per cent. turned out really smart men, whereas those who came into the shops as lads from the technical school—he was speaking from personal experience—with a fair knowledge of the three R's, the best invariably came on the top and the firm paid for their training at the university. There they got the kind of man who was going to raise the ideal. He believed that Mr. Hayes' ideal was not at all too high, but it was about a hundred years ahead of the times, and it would take at least that time to attain it.

Mr. E. Smith asked if Mr. Hayes thought high technical education would make good moulders. For himself he had an idea that the higher the education the more the moulding trade would suffer, because if they educated a young man sufficiently he would never be content to become a moulder. If everyone had this higher education, what would become of all the foundries?. They must always have practical everyday work, and he thought that the higher education it was proposed to give all young people would have the effect in later days of making them dissatisfied with their daily work. (Hear, hear.)

Mr. Pilkington, speaking as a school manager of some years' standing and as a manager of works, said that he was distinctly dissatisfied with the products coming from the schools. All the higher education was above the pupils' heads and of no use for moulders. The three R.'s were quite sufficient for them. Professors of technical schools and universities were not practical men, and had, with one or two exceptions, very little knowledge of practical work. He had very great difficulty in getting boys of the right type; they were more interested in football and cricket than anything else, and the education they received at the elementary schools and even that of those who had gone to finishing schools was most unsatisfactory, while there was the additional factor that it was the public money which was being wasted. The whole matter wanted thrashing out in a different fashion from that in which it was tackled at present. The appointments of teachers in technical schools ought to be made from a more practical point of view than at present. It was all very fine to teach chemistry and metallurgy and even engineering (though in the latter the professors and teachers were more practical), but the teachers had no practical knowledge of works. Mr. Hayes' Paper was distinctly interesting, but they must not lose sight of the fact that they wanted to make workmen. (Applause.)

Mr. Matthews took objection to the suggestion that a knowledge of the three R's was sufficient for a moulder and that education beyond that was waste. Even to a moulder, higher education was of great value in helping him to fill up his spare time. (Applause.) Education was of no use unless it instilled into young men a love of study, so that they would be able to acquire that knowledge which they found to be of value when they got on in business. Even with a smattering of education, when they had taken up their course of work they were more able to progress in that particular line. How much more interesting was moulding to a man who knew something of geology. One with a knowledge of only the three R's might know that a mould was a waster, but he would not know why. In one such case—the casting of a kind of cross in malleable iron with the two ends turned down and a large boss in the centre with a core—there was, of course, a tendency for the casting to contract, with the result that the whole thing split into four pieces. By simply bending the arms a bit he was able to get over the difficulty, though the man who was doing the job said "That may be the theory, it is not practice." An instance in support of his contention was his own study of building construction, which had been of infinite value to him in his work. It was true that he failed in the subject, but it was of immense value to him in reading drawings. A smattering of knowledge often assisted in making work interesting, and it was a great mistake to say that the three R's were sufficient for working men. (Applause.)

Mr. Hayes, replying to the criticisms of his Paper, said that he appreciated the value of those criticisms even more than the complimentary remarks of some of the other speakers. In reply to Mr. Gordon, he would say that the aborigine he pictured had identically the same ideal as that laid down for themselves. Taking into account the conditions under which he lived, the requirements were met, if he maintained and developed his physical and moral standard. It was not a question of giving men new ideals, but of ascertaining what was the real foundation upon which industrial activity was based. The ideal was already there, as stated in the Paper. No activity ever took place without some object to be attained thereby; and that object in all races was more or less in keeping with the one stated in the opening chapters of

the Paper. If the activity of any race was directed to another end, the result was inevitably extinction, be the race in question aboriginal or civilised. In fact, the introduction of some of the distorted ideas of civilisation to aboriginal races had in the past resulted in the extinction of certain of those races, simply by interfering with the operation of the natural ideal. He was afraid that many of the speakers laboured under the difficulty of not having read the Paper. He had not put forward any plea for the so-called higher education of all workers. Efficient work was necessary to maintain the physical and moral standard of the race, and to obtain that efficiency some training was necessary. The whole claim of the Paper was that that training should be carried to the point of full effectiveness instead of being stopped at a point where it had little effect on the efficiency of the worker. Training, or education, to use merely another term, had also to serve the purpose of raising the intellectual and moral status; and this would not impair the efficiency of a worker in any department. In answer to Mr. Smith, it was not to be assumed that a moulder required to be of lower intellectual or moral status than any other worker. It should be remembered that mankind were animals, but they were also more than animals. In accordance with the evolution of industry, they were drifting rapidly into the factory system of operation in almost everything, with its accompanying specialisation in every operation. That specialisation could not go on indefinitely if the ideal or objective laid down in the Paper were accepted; it would not even meet a mere physical ideal. Education—he did not mean college training—was necessary in order to make the inevitable factory system tolerable. It was not desirable to breed a horde of brutes to be handled by a few intelligent men. It was that very absence of education or the training of the reasoning faculties which was at the basis of all the social problems. While insisting that the worker must conform to the condition of industrial operations, he was not taught to develop his higher self. To teach a man how to live, and to raise his self-respect and capacity to indulge in healthy pleasures did not unfit him for the humblest necessary task. He (the speaker) had found some of the finest examples of intelligence (he did not say the best read men, but best from the moral and intellectual standpoints) among those who were not earning more than 30s. a week, and he knew many men whose activities were bringing them in a thousand a year whom he would class as infinitely inferior, since they had not yet reached that stage of education which enabled them to make the best use of their existence. In regard to the three R's, he would like to refer to the chapter in the Paper where he had outlined the requirements for the years of elementary schools. He did not mean to say that every boy coming out of an elementary school should thoroughly understand the subjects mentioned in the Paper, but he should be given the basis. Every elementary school child at the age of 14 should be so trained that he could at least grasp the elements of these subjects. They failed in that respect simply because the facts and principles were seldom presented in an intelligible manner. Most boys—and men for that matter—had not the slightest idea of the principle upon which English law was based, and the fact that equity was at the base of our legal system was almost beyond the comprehension of the average man. It did not take long to explain it. The elementary principles of chemistry, too, could be explained without the elaborate apparatus of the Council chemistry teacher and experiments which meant nothing to the child. A few words and well-chosen phrases could explain very definitely if the teacher knew how to do it. Language construction, too, ought to be instilled into the minds of the youngsters so as to enable them to understand that language was a means of gaining information and transmitting thought. He did not think that one youngster in twenty who came out of the Council schools appreciated the fact that language was at the base of the progress of mankind. Let them start boys in the right direction, give them facilities for getting higher education, and they would, if suitable, get it. In some industries some classes of labour did not require any training beyond the three R's. There was a certain grade of intelligence which naturally drifted to that kind of work. If education was to be made an effective means of forwarding industry; if education was to contribute to the success of an industry, it must not be stopped definitely at 14 years of age, but must be carried forward as far as necessary to make it useful. It was necessary in the interests of elementary education itself to carry it to an effective point. He did not wish to decry in the slightest degree the trained man. Training in any direction, higher or lower, must be made to meet the requirements of the work in which the man was participating. Referring to criticisms as to a boy being put to the wrong occupation and so forth, Mr. Hayes said he thought a fundamental purpose of education was to set each boy into the right line of work. To do this was an advantage of the country as well as to the boy. Mr. Fox Allin was right in saying that the question was a social one: all questions were social questions. Whatever subject was considered, whether it was higher chemistry or bricklaying, it all served a social purpose. With regard to his ideal being a hundred years in front of the times, he took that as a distinct compliment, but did not think Mr. Fox Allin was right. It was the belief of many very much more intelligent men than himself that the next ten years would see a radical revision of the educational scheme towards making it an effective servant to industry and civil well-being.

The Status of Engineers.

At a recent meeting of the Society of Engineers (Incorporated), Mr. William Ransom, A.M.Inst.C.E., read his essay on "How to Improve the Status of Engineers and Engineering, with Special Reference to Consulting Engineers," which was awarded the second prize in the Status Prize Competition last year, no first prize having been awarded. The author pointed out that engineers had many lessons to learn from the legal and medical professions, both of which excluded unqualified men and exercised a benevolent professional control over their members, and the State should recognise the engineering profession by giving it an official standing equal to that of other professions. The State should require engineering aspirants to pass a qualifying examination. Admission to the profession required to be carefully guarded, and the number of pupils allowed to an engineer should be regulated by the extent of his practice, while the climax of the period of pupilage should be a State examination. Much more might be done to make examinations of practical value to those who prepared for them, but no other form of test was possible. When State recognition was obtained for engineers, the members of the profession would constitute one great society, amalgamating the existing societies into one body, which should have the control of professional matters and be the mouthpiece of the profession. Such a society would necessarily have sub-sections dealing with special branches of the profession. While the growth of specialisation must be recognised, it was essential for those who were beginning their training for the profession to acquire a sound general scientific knowledge before beginning to specialise. The State should fix a scale of minimum professional fees. Consulting engineers were comparatively few in number, and on that account the public placed a high value upon their services.

Sand-Core Sockets for Vertically-Cast Socket and Spigot Pipes.

By Sidney G. Smith

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The following method is sometimes adopted in making sand-rammed core sockets for ordinary socket and spigot pipes.

Instead of striking the core socket up in loam, as is the usual practice in large pipes, and which practice has been described previously, the same socket plate is used with iron core boxes to fit, and the cores

Fig. 1.—Assembled Section of Core Boxes.

are rammed in medium-strength milled sand. The difference in the two methods regarding economy and good results is one of opinion. The writer is inclined to the former method, *i.e.*, striking up the sockets in loam, as this, when properly and carefully done, is satisfactory from any point of view.

Fig. 1 shows an assembled section of the core boxes on the ordinary socket seat plate A. It will be noticed that this socket is an unusual and deep design (5½ in. deep), hence the necessity of a three-part core box. If the internal shoulder of this socket had not been rounded as shown, the top piece of the core box D

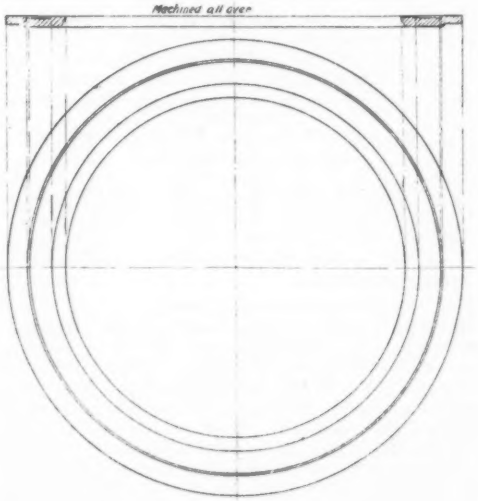


Fig. 2.—Part B of Core Box.

(Fig. 1) would not be necessary; hence with ordinary sockets this part is not required, and the top shoulder of the socket would finish off with core box C. Fig. 2 shows section and plan of part core box B; this part is in one piece, and is simply made by being struck up in loam. In Fig. 3 is shown section and plan of part core box C; this part is made in two halves, cottered or cramped together when in use. It is simplest made in sand from a half pattern. Fig. 4 shows section and plan of part core box D, which is in one piece, being also struck up in loam. This additional piece is very rarely required, except, as before said, with specially-designed sockets.

Fig. 5 shows the seat plate A, which receives the

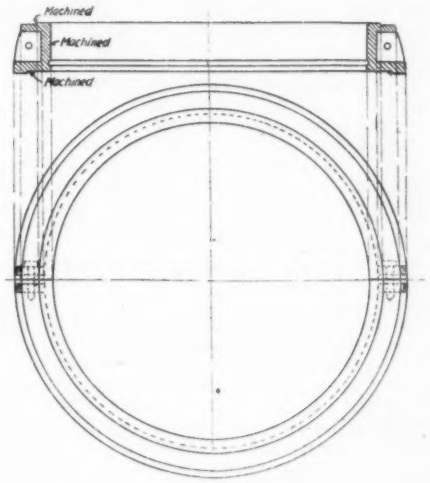


Fig. 3.—Part C of Core Box.

main or body core in the cup, with the socket sand core finished, and the mould ready to be lowered on to it.

For the smaller pipes, say 18 in. and less, the bottom and the internal shoulder of the socket are formed

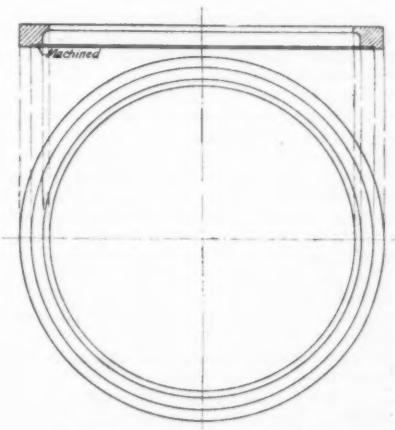


Fig. 4.—Part D of Core Box.

with two cores, or sometimes only one. In either case the socket core carries the weight of the core barrel (see Figs. 6 and 7).

The Preservation of Iron.

In a Carnegie memoir submitted to the Iron and Steel Institute by Dr. J. Newton Friend, some useful information is given as to the value of paint as a preservative for iron and steel.

Dr. Friend's results reveal a number of interesting facts of considerable technical importance which may be enumerated as follows :—

(1) The surface of a paint film does not always give a correct idea of the extent of corrosion taking place beneath.

(2) The addition of small quantities of paraffin wax to paint destined for the protection of iron and steel exposed to the air reduces the corrosion very appreciably. If the paint is required to set at the normal rate, not more than 1 lb. of wax should be used for every 1,000 lbs. of oil present in the

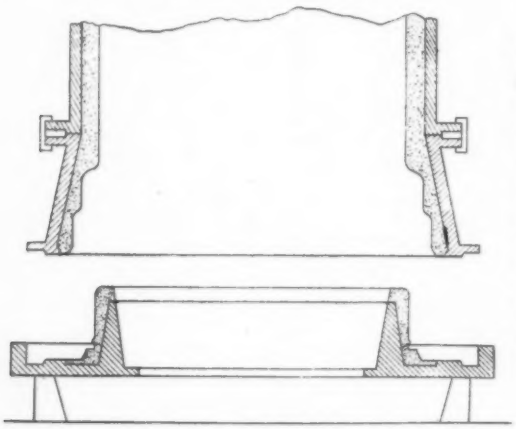


Fig. 5.—Seat Plate A with Socket Sand Core Finished.

paint. If, however, the rate of setting is less important, the amount of paraffin wax may with advantage be increased to 3 lbs. per 1,000 lbs. of oil. This latter is, roughly speaking, equivalent to 2 lbs. of wax per ton of ready mixed paint—an estimate that is sufficiently near for the purpose.

(3) In the case of plates immersed in water the addition of the paraffin wax seems rather to assist corrosion than to diminish it.

(4) A fine pigment is superior to a coarse one in the preparation of protective paints, a fact which is now generally recognised.

(5) It is generally believed that two coats of paint preserve an iron surface from corrosion considerably more efficiently than one coat. Liebreich and Spitzer have recently called attention to the fact that in their experiments, by increasing the number of coats of paint not only was the corrosion not reduced, but it actually increased, as if the extra coats stimulated corrosion. Dr. Friend's results lend support to the work of Liebreich and Spitzer.

(6) It is always found that a rusty surface when painted yields unsatisfactory results, and the careful painter removes the rust prior to the application of paint. Undoubtedly this is necessary in damp weather, and it is also necessary to scrape off any scale and thick coats of rust.

It occurred to the author, however, that a slight coating of rust, absolutely free from caking and lumps, might be an advantage rather than otherwise, if perfectly dry, for two reasons :—(1) Fine rust is practically a pure ochre, very free, in the case of wrought iron and steel, from silica. Hence the surface is very absorbent, and if painted with a good coating of thin paint a similar result may be expected as by first laboriously cleaning the metal and then painting with a thicker paint—that is, one containing more pigment in proportion to oil than the former. (2) If the iron surface is sandpapered down it is made much smoother, and its

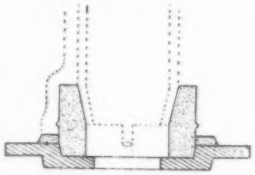


Fig. 6.—Socket for Smaller Pipe formed with Two Cores.

area is reduced to a minimum. If, however, the rust is left on as a thin coating, the underlying surface of metal in contact with the rust is slightly pitted and uneven. Hence when the paint is applied it has a larger surface to grip, and its tenacity will therefore be increased in proportion.

It was found that plates suffered far less from corrosion when painted in a rusty condition than when first polished bright before painting. This is a remarkable result. It would seem, therefore, that when the painter is called upon to protect by painting thin sheets of iron, such as galvanised iron, which has already rusted somewhat, any lumps of scale should be removed, and a coat of paint applied in warm, dry weather to the rusty surface. The danger of the sheets rusting through will thus be considerably less than if the rust is first care-

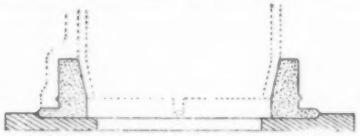


Fig. 7.—Socket for Smaller Pipe formed with One Core.

fully scraped off and the metallic surface polished with sandpaper before the application of paint, as is the more usual custom.

Grinding of Metals.

Mr. Law, a Sheffield Factory Inspector, reports that, though exhaust ventilation has been provided throughout the grinding trades, he is not satisfied that it is perfect in all cases. The cyclones are already wearing out by the constant whirling of the dust round the inside, and the corrosion on the outside by the weather. As a substitute for these, brick chambers have been built, connected by a pipe to the chimney stack. They appear to be satisfactory and to prevent the dust from escaping into the atmosphere. He regrets that the workmen themselves do not carry out their share of the duties to the full extent, and finds exhaust ducts stopped up owing to improper things being allowed to enter; hoods not properly adjusted; glass in the hoods broken; and sometimes grinding being done with the valve between the hood and the duct closed. Again, in those places where respirators have to be used, men are frequently found racing stones without them, and others working in the room at the same time.

The Economics of Industry and Education.

By Alexander Hayes.

(*Continued from page 454.*)

Chapter VI.—The Present Educational System.

The increasing organisation of productive activity during the last century has revealed the necessity for systematic training of young labour on a national basis. The training associated with the guilds and their apprenticeship had served well enough up to a point, but, as previously outlined, the inflexibility of the system in the face of the larger requirements of industrial development, limited its effectiveness to a few trades, while also the factors mentioned tended rather to decrease that effectiveness than expand it. There consequently arose a demand for systematic training on broader lines, and covering industry as a whole rather than sectional trades; and since schooling and the general development of the mental faculties was acknowledged as an essential part of training, a demand for general schooling was voiced.

It may be fairly claimed that the educational or schooling system existing to-day has developed as the result of a demand for opportunity which has neither been clearly understood nor clearly expressed. It must be regarded largely as experimental and open to radical change and extension to meet the requirements of industry and civic well-being. Too frequently our educational system of to-day is regarded, not as a means of promoting industrial and civic progress, but as a concession to the demands of a clamouring democracy for the opportunities which, within the memory of living man, were confined to a few sections of the community only. It should be regarded as a more highly organised system of preparing the worker for industrial and civic activity. This idea is dimly discernable behind the operation of our school system, but is frequently overlooked in discussing the efficiency of the system.

The writer does not condemn wholesale the present system, for it is decidedly improving; there have been, during the last 10 years, great advances towards the right end. But still the product of the elementary schools is far below the result which might be obtained. It would appear that the process has, in most cases, stopped somewhat short of actual usefulness, though proceeding in the right direction. Such being the case, attention may be turned to finding where the defect lies, and in what way it may be remedied. The present system is not so much incorrect as incomplete, and while it is developing generally on the right lines, the rate of that development is not in keeping with the requirements of industry. It yet remains to properly link up our schooling system with that activity for which school training should be a preparation. At present there exists a gap which to a great extent nullifies the good effect of the education given.

Chapter VII.—Effective Education.

It has been shown that the process of training and preparing for industrial activity is an economic necessity, and it now remains to discuss the exact nature or mechanism of that process. It may here be stated that education, to be efficient, should be very wide and general, and not confined to one or a few mental faculties. Any particular calling may, and does, demand that the education of its operatives be carried further on certain lines, and that development be specially concerned with those facilities which most directly bear on the requirements of the calling. But that does not affect the main process of education. It is more than a simple drawing forth of latent capacity; it is the application of the necessary stimuli for proper development, and hence includes the wide range of physical and mental faculties and moral perception.

Having granted this much, it must be decided at what point this training or education is to commence The question is strictly a physiological one, for it must be remembered that all development is the result of effort. In that case the development cannot commence too early. From the cradle onwards the child responds to the stimuli, whether mental or physical, which it receives, and all its efforts (and hence its development) are controlled by that. It must, of course, be borne in mind that the individual always responds to stimuli in accordance with its own particular inherent tendencies, and hence the same stimulus may produce quite different results with different children. It remains, nevertheless, that training or education (the application of stimuli) should commence at the latest with separate consciousness. The parent or guardian alone can be made responsible for this preliminary training, and all intelligent parents appreciate the value of providing the proper mental food as well as the physical. The fact that modern life does not permit the necessary contact of parent and child to continue that training indefinitely, necessitates the organisation of school systems—this being only a further development of the economy of industry. But the institution of this organisation does not relieve the parent of his or her responsibility for providing whatever other training or instruction is possible. Lack of appreciation of this fact is the cause of much of the apparent inefficiency of our school system. A point that cannot be too often insisted upon is that organisation in any department of life does not relieve the individual of any personal responsibility whatever. It may change the line of operation, but the individual's responsibility for performing properly all that is within his sphere still remains, and in fact increases by reason of the same exigencies which render organisation necessary.

The conclusion is, then, that schooling systems are means for *aiding* the parent in the education of the child, and for providing such necessary information, or the facilities for its acquisition, as are not possessed by the parent. The main stimulus to the acquisition of that knowledge must come from the home whenever possible. It will probably take at least one complete generation of training to re-instil this true conception of responsibility into parents generally; for a great misconception has gradually developed, and was to a considerable extent fostered by the institution of compulsory education before its true purpose was understood.

From the foregoing it will be evident that the purpose of an educational system is not only to instil a certain sections of rules and formulæ into the mind of the pupil, but to develop the mental and physical capabilities. This is gradually being acknowledged in the much stricter supervision now exercised over the physical condition of the child than was the case even

ten years ago. With this the writer is in cordial agreement, but he would nevertheless again insist that an essential function of education is to equip the pupil for becoming an efficient citizen and unit in the industrial community.

In training, the first factor to be remembered is that a mental effort is required to impress any idea on the student, therefore, a stimulus to that effort is more necessary than the placing before him of abstract information, ready to be absorbed. Now that the home stimulus is largely minimised by the compulsory system and lack of contact of parent and child, it becomes necessary to supply a substitute. Industry cannot now afford to leave to the discretion of each individual whether he shall become proficient or not, but at the same time mere compulsory attendance at schools for the presentation of abstract information does not constitute education towards efficiency. It may, and often does, merely instil a prejudice against the process of acquiring knowledge. Far greater good can be attained by tactful rousing of the ambitions in the same way that many a parent yet instils a desire for knowledge into the mind of the child by presenting that knowledge as something worth acquiring. This process should be followed and accompanied by a clearer representation of the applications of abstract knowledge in commercial or industrial life, and since this is far better accomplished during contact with industry, here is still another ground for favouring the merging of schooling into industrial activity.

At this point we may outline the essentials for the correct system of schooling and education. The objects to be attained have been sufficiently well enunciated in the foregoing to render adequate for the present purpose a simple statement of conclusions as to the general principles. In this connection the writer has no great fault to find with the existing system of early elementary schooling. The only suggestion is that compulsory attendance at so early an age as five years in many cases militates against physical development, while not materially assisting the mental progress. But particularly in view of the recent marked improvements in the conduct of the younger classes in elementary schools, they may reasonably be accepted as fairly satisfactory. From the age of about nine or ten onwards, however, there appears to be considerable room for improvement. There is too great a tendency to keep rigidly to set lessons and formal systems of instruction regardless of their effect upon the mentality. It is unfortunately very difficult to combat the tendency to produce a class of pupils who are crammed to qualify by examinations rather than a class who, while not being specifically competent to pass in any direction, are yet being instilled with a desire to obtain knowledge, and being given an incentive to general expansion of intelligence. It is far more beneficial to instil into the minds of the pupil the desirability of studying English history for the interest it holds than to insist that the number of wives possessed by Henry VIII. be carefully memorised. Yet we see scholar after scholar leaving the elementary schools with no conception of the importance of historical study or of the application of the many sciences and studies with which they have been given a slight acquaintance.

Schooling, then, from the age of, say, 10 to 14, must be made a process of engendering the habit of acquiring knowledge for the interest it holds, and mere abstract statements of fact to be memorised should form as little a part as possible, compatible with instruction. Instead, more attention should be given to imparting the principles of logical thought and generally developing the reasoning faculties of the child, so that by the time the elementary course is finished the child will have acquired the habit of applying his reasoning faculties to every question that arises instead of passing by as unintelligible all subjects in which he has not previously been drilled. It is so hopelessly impossible to cram more than a tithe of the mental requirements into a boy during school years, that failure is bound to follow anything but the development of that mental habit which allows the process of acquiring knowledge to proceed continuously. The last two years of schooling should teach the pupil the elementary principles of mathematics, social economics, inorganic chemistry, the principles of language construction, and the fundamental principles of English law. It is not even necessary that the final application of these subjects be dealt with to any great extent; it is rather essential that the process of applying the principles be taught. At present school instruction avoids explaining the principles and trifles only with their application in minor directions which are practically unintelligible until the principles are understood. When the principles of any subject are properly mastered their application becomes a simple matter under any circumstances. Moreover, with the principles of the foregoing subjects well appreciated, a host of matter with which the student comes into contact in the course of his daily life becomes intelligible, and, hence, instructive, whereas without this preliminary knowledge of principles no instruction is received.

Coming now to the point at which elementary schooling ceases and industrial training commences, since the latter should be a continuation of the education of the pupil, it must essentially be made an extension of the former to include intimate contact with industrial operations and special instructions in relation to those operations. Whatever the vocation may be which the pupil follows after leaving the elementary school, if that calling requires any training which can be better imparted at a school or college than in the course of the work, that schooling should form an integral part of the industrial training. There are conceivably many classes of unskilled labour which require little such instruction, and no benefit would be received from continued schooling after the elementary stages. It should be possible, however, for any who started in those grades of occupation to still continue, if they wished, the studies commenced in the elementary schools. This, however, would have to be optional with the pupil. In the higher grades of labour the training should be compulsory as forming an essential part of the industrial instruction. It would be necessary to determine approximately the requirements in regard to schooling for each industry or calling, and to then make that schooling compulsory for everyone under a certain age; and every plant operated at the work in question or employing juvenile workers in the directions mentioned, should be compelled to allow the necessary time for instruction, such instruction to be given either in State schools or schools conducted by large works or combinations of works under the supervision of the State. It will, of course, be understood that such a continuation schooling would vary in time and nature to meet the trades concerned, and in the case of some trades would be reduced to a minimum.

The instructors, in conjunction with the elementary-school teachers and employers of labour, further, should form advisory committees for the starting of any boy in the most suitable calling, as shown by his capacity at the moment. Moreover, these committees could assist in the transference from one class of labour to another of any boy ultimately found unsuited for his immediate vocation, such change necessitating, naturally, a change in the instruction to be received.

There have been, and still are being, put forward ambitious schemes for introducing university training to pupils of the poorer class—this in answer to the discontent caused by so many positions of control and prominence being given to university graduates. The writer is not in agreement with the majority of these schemes, for the reason that university training itself is frequently no preparation at all for efficient control of industry and the guidance of labour. The most efficient officer in the industrial ranks is he who has passed through intimate acquaintance with the various requirements, and who at the same time has participated in that self-education which constitutes solid progress and development, as distinct from the absorption of abstract instruction. It is quite reasonable to supplement this self-education and development, if found desirable, by the higher schooling of the college or university, but to place so many positions, as at present is being done, at the disposal only of university or college students is to depreciate natural ambitions and efforts towards development of the rank and file, while not obtaining the most efficient officers.

Under a system which allowed advancement by personal effort, regardless of the starting point, to any position of importance or prominence in the industrial world, and without the severe handicaps which the present system imposes upon those starting in the low grades, the whole standard of ambition and intelligence of every rank would be raised. There is much unrest and discontent at present caused by the consciousness that inferior intelligences are being given positions of control and importance solely by reason of presumed training received as the result of a different starting point. It is not as though the crafts demanded solely the poorly-trained worker and a few officers of abstract training; it is well acknowledged, particularly in the engineering trades, that there is a considerable scarcity of competent "middle-rankers," *i.e.*, men who have reached well above the mediocre, and who, by reason of the incentive of prospects ahead continue their development through all the stages up to top capacity. The writer considers that there is undue stress at the moment laid upon university training, for under the present system it often engenders a sense of self-importance, not necessarily accompanied by qualifications. University training as a climax to sound self-education is admirable and highly to be desired, but that self-education which results from practical experience and the exigencies of industrial life is often more comprehensive than that obtained by the instruction received at school or college.

Under the present system much attention and training is expended upon pupils who have not gone through the best preliminary for receiving such finishing, while others who would very materially benefited by this training are barred. The result is that industry does not receive the return for the money expended on higher or elementary education which it ought to receive. The writer has no hesitation in putting forward these assertions, since he has come into personal contact with a large number of so-called qualified university students whose intellectual capacity was below that of the average mechanic, and who, apart from the semi-acquaintance with the classical subjects, and superficial intimacy with the higher sciences, had received little preparation to qualify them for useful productivity, either as officers or routine workers in the industrial ranks. It is, of course, under present social conditions, useless to demand that the higher training of the university be applied only as the culmination of education where the quality of the student has been proved, but at the same time it might be extended very considerably to continue the development of those students in the industrial ranks who for various reasons have now to be content with attaining only a slight improvement on the position of the routine worker, despite the fact that with a little assistance they could with more competence fill the positions of officership than many many who now do so.

It will probably be contended that already there exist scholarships, bursaries, and so forth, by means of which suitable scholars may obtain university training. To some slight extent that is so, but for the most part they require that special capacity shall be proved by examination at an age when the majority of the ultimately most intelligent boys have not any brilliance to show. The most suitable boy for higher training frequently does not exhibit the possibilities of his development until he is well past the age for such scholarships; while, on the other hand, many who do qualify early for the higher training, give most unsatisfactory results for the attention paid to their advancement. It is an acknowledged fact that a very large proportion of scholarship boys do not continue the development which their early school days promised.

Chapter VIII.—The Factory System.

As has been shown, the development of organisation during the last century or more has been accompanied by a natural decline in individualistic operations, until very few products are now consumed by their actual producer. In some directions this has only necessitated combination under one general head for the purpose of economical distribution and exchange, the actual operation of production being much the same as before. In other cases, however, it has given rise to what is known as the factory system—the extreme application of the principle of the division of labour.

Under factory operation the knowledge required by each individual is small compared to that required by the individualistic system, and is frequently confined to a single routine operation. Apart from the problems (an important one of which is discussed under the title of "Flexibility of Labour") which such a system presents when the workers are only trained for single or sectional duties, it cannot be reasonably claimed that the system is conducive to a high intellectual standard. This is reflected in the incapacity of some workers to adapt themselves to new methods and appliances. Moreover, all the work of a factory's operations cannot be conducted by this class of operative, and hence there is witnessed a condition of things in which a minority of highly-skilled and trained labour organises and controls the operations of a mass of routine workers. To some extent this is advantageous, but it has several drawbacks. For example, very many industries have to depend largely on operatives with general and varied qualifications within the limits of their trade; but the ever-increasing segregation of labour into the two grades above mentioned—the highly skilled and the untrained—is steadily denuding those trades of the supply of capable craftsmen, and instead recourse must be had to one of the two classes produced by the factory system, neither of which is suitable to fill the place of the old craftsman.

To meet the requirements of those trades other than factory trades necessitates training a portion of the worker to well above the standard of the present factory operative, but on different lines to the highly-trained factory manager. But there are reasons why factory operatives also could with advantage be trained to a higher standard than the present system demands—for it must not be concluded that even the present organised factory system is necessarily

the most efficient ultimately, though it may be more economical than the system of self-contained individualistic production. The factory system has developed in accordance with the dictates of industry, but to conclude that it is essential in its present imperfect form is to ignore the fact that industrial evolution is still proceeding. It is more logical to conclude that since the system contains certain features which are wasteful in the utilisation of the resources of labour or productive capacity, it will eventually be developed on lines which will avoid that waste. It has already been proved in some industries that factory organisation can still obtain while the soul-killing and development-restricting features are eliminated. It now remains to so conduct the organisation of industry that in no branch shall the objectionable features of factory operation maintain, though the organisation may still be retained. Factory workers must be educated to a wider comprehension of their place in the scheme of industry and of the relation of the individual and his work to the community. They must be given the necessary incentive to find and enjoy that artistic and intellectual side of life which alone can make the existence of factory conditions permanently tolerable. There is no hope in the future of dispensing with the high organisation of the factory system—the demands of Nature and the development of the species necessitate it: but it is possible for each individual to have a more perfect conception of his relation to his environment, his duties as a member of a self-supporting community, and the intellectual and artistic possibilities of existence, despite high organisation. The enjoyment of these possibilities can only be attained when they are earned —when the product of each worker's labour is such as to provide them; and this can only be secured by industrial efficiency, which in turn can only be secured by education or training.

Much imposing discussion and comment is often indulged in regarding industrial unrest and its causes. The writer considers the root cause is the rousing of the national conception of possibilities of a higher standard of living without at the same time raising the efficiency which will provide for the maintenance of that higher standard. In short, the development of consciousness has outstripped the advance of capacity.

Further, the writer would claim that the problems presented by the unequal distribution of wealth will automatically adjust themselves, providing the advance in efficiency of all classes is kept up to the necessary standard. There can be no solution to the problem so long as the economic value of a large section of the community is lower than the value of the share of wealth they demand—as is the case with a large body of labour.

Chapter IX.—The Flexibility of Labour.

Owing to the fact that the development of organisation has been intermittent and very erratic, there have risen at various times a number of features of a temporarily objectionable character. For example, in many industries, the introduction of machinery and systems of organisation has suddenly diverted from its old application large bodies of labour, and while a definite economy has been effected in the production of the articles formerly resulting from this labour, the labour itself has not been readily re-absorbed. It has, of course, been ultimately absorbed in other directions, with the net result that the productive capacity of the nation has been increased by approximately the corresponding amount, but the inflexibility of this labour and the difficulty of suddenly re-absorbing it was, and is still, a somewhat acute problem. Side by side with this is a similar difficulty resulting from the decline in demand for various products owing to the vagaries of public fancy, the introduction of new products and similar causes and here again labour is being thrown idle which requires to be re-absorbed. Since this labour is only trained for narrow and specialised operations, and has, as a rule, not reached that standard of intellectual development which allows the ready acquisition of capacity in some other direction, there are witnessed frequent additions to the very lowest ranks of casual labour, these additions frequently representing former competent labour in special directions.

It will be readily seen that here occurs large waste of productive capacity which, under ideal conditions, would be re-directed to the benefit of the community. The writer considers that it is an essential function of education to re-direct this labour into useful channels, or to at least assist its re-absorption. It is an education problem, in so far as lack of training is the chief missing qualification by reason of which the labour is unemployed. On this account it appears quite logical to claim that wherever possible all branches of labour should be developed intellectually beyond the immediate requirements of the work employing them, so as to give a certain flexibility to the labour supply of the country. At present it is extremely inflexible, and hence we witness the phenomenon of some branches of even the same trade suffering from lack of labour supply, while other branches are overcrowded. The economy of training labour beyond the requirements of the specialised system of factory operation will be apparent when it is considered that the productive capacity would be greatly increased with very little extra outlay in the course of the training period.

The good effects of this high development would be experienced even in the factory operations; for in almost every industrial works a greater flexibility of capacity than is produced by the training given by the work itself is highly desirable. To increase the range of wage-earning capacity in the workers as a whole would be to strike at the root of some of the standing economic problems of the day, amongst which are the problems of unemployment and excessive casual labour; also those of intermittent scarcity of labour in different industries.

Chapter X.—Training from the Works' Standpoint.

We may now consider some of the aspects of the question of training from the standpoint of the works manager, and deal with the problem of whether the works can afford to train their boys and educate them generally with the object of making them efficient operatives at the age of, say, 20, rather than employing them merely for what they are worth as operatives at earlier ages. It is, perhaps, natural that from the works manager's standpoint the only economics are those of his competition with his neighbour, and in the face of that competition it is difficult for him to start at the base of the economic problem and develop the correct structure of which his concern is necessarily only a part. He naturally desires to be the centre of that structure himself, and insists that, unless a scheme gives him prominence, it is bad economics. Under the conditions existing at the moment, and from the individual standpoint, it is admittedly bad economics to undertake expense in the training of operatives to supply the trade at large, while competitive firms are declining that expense and using the same material to exploit for their own profit. At the same time the attitude is at the base false, but can only be corrected by efficient organisation and control, which will insist upon the necessary outlay by every works

to efficiently train a proportion of operatives in keeping with the number it employs.

It should be remembered that all the expenses of the community must be borne by industry, since that is industry's prime purpose; and the returns from industry must be made to pay for the training to produce those returns. To the writer it appears that the simplest way to attain this is to prohibit the employment of any untrained labour, unless the necessary facilities for training it are given in return. It should be apparent, from the contentions previously put forward, that this claim is economically sound, as it tends to the greatest ultimate efficiency, and this will be still more apparent if the productive capacity of the workers as a whole be considered as one of the national resources. There is no opposition raised to the proper treatment of, say, our timber resources; any suggestion for the conservation, development and correct use of our forests is generally accepted with approval. Why, then, should we permit the wasteful application of the still more important resource, the nation's labour, when better results can be obtained by correctly developing, training and applying it?

If, then, it is acknowledged that industry benefits by the training in question, the principle is economically sound, and it only remains to apportion the cost according to the amount of labour employed by each individual. A direct educational tax on each employer per head of employed would, perhaps, correctly proportion the cost, but that course is open to various objections, the chief being a constitutional aversion to such impositions. The same end is served if each works is compelled to allow the necessary time for such training (arranged to suit its individual convenience), and the monetary cost is defrayed from the national exchequer.

It has been put forward as an objection that after spending considerable time and trouble in educating apprentices, there is no guarantee that the employer will ever reap any benefit from their enhanced capacity and value. This is true, if only one employer among several competitive employers undertakes the course of training in question. But if that training were part of the normal industrial operations of every employer, each would be placed on the same plane, and none would be in the position of employing the product of another's training without placing at that other's disposal a similarly trained man.

At the present time it is readily understandable that only comparatively large firms can afford to go to the expense of thorough training; they reap the benefit of their own good training by being able to offer greater inducements for the retention in their own employ of the trained men.

There is also another feature which must not be overlooked. Under a proper system of training the employer reaps considerable benefit from the enhanced value of the pupils he is instructing, and this during the period of training itself, particularly the latter part of that period. To attain this, however, requires more than the casual and unorganised attention to the pupils and their work which characterises many shops.

A word may here be said in regard to the payment of apprentices—a point upon which there is considerable diversity of opinion. The writer considers that it is useless to agitate for increased pay for apprentices under any system—the pay must be left to automatically adjust itself to the proved value of apprentices under the system adopted. Particularly were the system of training an organised part of industrial operations, the boy labour available for employment and training would, as a matter of course, be paid in accordance with its commercial value to the employer; and under proper organisation that commercial value would approximate very closely to the *real value, i.e.*, the usefulness of the labour as a productive medium.

Objections have been raised against widening or elaborating the field of study in elementary schools, as suggested by the writer, on the grounds that the average child would never master the subjects unless the age limit were put up to 18 years at least, which would impose a breaking strain on the financial resources of the parents. Further, it is contended that, as the trade to be followed by each scholar is seldom decided during school life, the ground covered would need to be enormous to be of use.

These contentions appear to miss the whole sense of the suggested scheme of training. In the first place the syllabus of subjects would not need to be enlarged so as to cover the requirements of all trades; the subjects would be only those common to all trades. After participation in industry was commenced, the student could specialise according to the demands of his calling, and any alteration in that calling which was found desirable would be met by a corresponding alteration in the direction of the specialised study.

As regards the strain upon the resources of the parents, it is questionable whether this is such an important item as it first appears to be. In the very poor ranks, to-day, where boys become wage-earners at unduly early ages, a large proportion of the wages earned never goes to assist the parents in the upkeep of the boy, but is spent in directions incidental purely on the occupation he is following or is wasted in unnecessary amusement.

Moreover, it must not be concluded that because a boy is undergoing part-time training during the first four or five years of his work that he is not receiving payment, or is even getting less than at present. If he only received payment commensurate with the actual time he was working, though he might get less for the first year, after that his capacity during his shorter working time would, in most cases (by reason of higher intelligence and understanding), be as great as at present in the full working day. Again, the supply of boy labour would be curtailed in proportion to the time taken off for study and instead of excessive competition between inefficient, cheap labour reducing the wage of the boy, the wage would rise in its commercial value, *i.e.*, its value to the employer.

Another point to be considered is that the curtailment of the supply of boy labour would give better opportunities for employment of that class of labour which, past its prime, often cannot find employment at even trivial wages against the keen competition of boy labour fresh from school. In fact, the writer contends that there is a rather large supply of adult labour of the class mentioned which would far more efficiently operate at work now engaging the attention of boys, and at a wage not materially greater than that commanded by many boys who would be better undergoing a course of training for greater ultimate efficiency.

Finally, the writer would remark that only by keeping the ideal or objective permanently in view can the correct relations between labour and capital be appreciated properly. On superficial observation they appear to many observers two distinct and opposing factors, and it is not until a perspective view of the whole range of industrial activity and its true purpose is taken that the significance of capital and labour in their relation to each other can be appreciated.

In its essentials the difference is chiefly one of range of operation in the same organisation known as industry; each has a part to play in the attainment of the same ultimate purpose, and though this may not be apparent in the face of personal aims and immediate considerations, it is the ruling factor, and it cannot be ignored indefinitely by either party. Nevertheless, we find some so-called economists propounding imposing, but foolish, doctrines about the essential antagonism between Capital and Labour, as though Capital were one natural force operating in a definite direction and Labour another force operating for quite a different end and against the interests of Capital. To any but the wilfully obtuse or the ignorant, the two stand simply as integral parts of the one great organisation, industry; and though the individual may so manipulate his duties within his own sphere as to benefit himself at the expense of another, the relations between his duties and the other's duties in the one great organisation remain the same.

Summary of Conclusions.

The foregoing has touched only in a brief and elementary manner the essentials underlying industrial activity and education as an aid to that activity. There are many side issues of a more or less contentious nature which are involved, but they cannot be dealt with at the moment. Instead, the writer will summarise the conclusions arrived at. These may be stated as follows:—

Chapter I.—(1) That the essential object of industry is the provision of what is necessary for the maintenance, development and reproduction of the species, first from the physical and later from the intellectual and moral standpoints.

(2) That although any particular scheme or line of operation may involve details which conflict with the ideal, the advantages may often be retained and the objectionable features eliminated.

(3) That the operation on lines contrary to the industrial ideal must react to the detriment of the industry and often the individual so operating.

(4) That this reaction may be so slow as to be obscured until the subject is carefully considered in regard to its fundamental principles.

(5) That once a definite ideal of industry is established, every industrial question raised can be directly referred to it and the defects in any system discovered.

Chapter II.—(1) That industry is a process of organisation in the interests of the race, rendered necessary by:—(*a*) Improvement in the standard of living or increase in the total requirements of the individual; (*b*) decrease in the products obtained from natural resources for the same unit or amount of energy; (*c*) increase of the population utilising unincreasing resources, and hence the necessity for their more perfect utilisation and the discovery of further resources; and (*d*) the demand for increase in the effort applied to resources, or improvement in methods or processes and apparatus so applied as to increase the production for the same amount of effort.

(2) That the application of invention and science has (*a*) rendered production from available resources easier; (*b*) discovered new resources and substituted others for those being exhausted; and (*c*) converted into usuable resources a large variety of formerly useless materials.

(3) That the purpose of each individual's participation in industrial activity is to create or produce all that is necessary to satisfy that individual's requirements, and that all useful work is directly associated with the discovery and utilisation of Nature's resources, however applied.

(4) That useful work includes the obtaining and preparation of materials, the handling, distribution and processes of exchange of those materials, the attention and mental effort required in organising that distribution and exchange, the devising of appliances to aid all branches of industrial activity, the attention and effort required to train the young and inefficient, and also all the labour required to create and place available the means and facilities for enjoyment and recreation which are demanded by the whole community.

(5) That increasing organisation has largely eliminated the domestic or individualistic system of production and given place to the factory system of concentrated activity; that this has been greatly aided by the development of the power plant; and that henceforth the factory system must be taken into consideration as a permanent factor.

(6) That there is a practical maximum beyond which organisation and specialisation cannot go if it is to serve the purpose of industry.

Chapter III.—(1) That the resources of a nation include all the raw materials, facilities for obtaining and converting them, all service and facilities exchangeable in commerce, and the aggregate capacity of the nation to produce and utilise all the products required by the nation.

(2) That the degree of efficiency of the workers in all departments of industry governs the nation's capacity to meet its requirements.

(3) That as a general principle each individual or section of an industrial community should produce that which it is most capable of producing, subject to that commodity being required or being exchangeable in the world's markets for other necessary or desirable commodities.

(4) That any district, while producing its most readily produced commodity, may still suffer from the competition of other centres better situated in regard to facilities or resources, and can only adjust the balance by bringing greater intelligence to bear on its operations.

(5) That an important function of education should and will have to be the production of a flexibility of wage-earning capacity.

Chapter IV.—(1) That the required preparation for participation in industrial activity, the time it should take, and the extent to which it should be distinct from industrial activity itself differ in the case of almost every trade; but that at least the first twelve or fourteen years of life should be devoted to physical and mental development, without active contact with production.

(2) That at a certain stage training becomes barren, unless the pupil is at the same time brought into touch with the work to which the training relates, and that this constitutes a strong plea for merging the preliminary training into the final training of actual participation in production.

Chapter V.—That the old apprenticeship system, while adapted to the conditions in which it arose, requires modifying in strict accordance with recent social and economic changes.

Chapter VI.—(1) That the present educational system was devised to meet the necessity for systematic training on broader lines, and to prepare *all* potential workers for industrial activity rather than only those who might receive instruction in their particular craft.

(2) That it must be regarded largely as experimental and open to radical change and extension to meet the requirements of industry and civic well-being.

(3) That the present system is not so much incorrect as incomplete.

(4) That the logical basis of national education is not the provision of facilities for the advancement of the individual, but the making of that individual's capacity available for the service of the community.

Chapter VII.—(1) That the organisation of education does not relieve the parent of any personal responsibility whatever.

(2) That schooling systems are means for *aiding* the parent in the education of the child.

(3) That routine instruction should be accompanied by a clearer representation of the applications of abstract knowledge in commercial or industrial life.

(4) That schooling from the age of 10 to 14 should be made a process of engendering the habit of acquiring knowledge for the interest it holds, and mere abstract statements of fact to be memorised should form as little a part of school routine as possible, compatible with instruction.

(5) That the habit of applying his reasoning faculties to every question that arises should be encouraged and developed in the pupil, so that the process of acquiring knowledge may proceed continuously.

(6) That industrial training should be an extension of the education of the pupil, to include intimate contact with industrial operations and special instructions in relation to those operations.

(7) That if any calling requires training which can be better imparted at a school or college than in the course of the work, that schooling should form an integral part of the industrial training.

(8) That university training itself is frequently no preparation at all for efficient control of industry and the guidance of labour; but that university training as a climax to sound self-education is highly desirable.

(9) That existing scholarships, bursaries, and so forth, by means of which suitable scholars may obtain university training, serve relatively little purpose, since they generally require that special capacity shall be proved by examination at too early an age.

Chapter VIII. (1) That the factory system has developed in answer to the requirements of industry, but must not necessarily in its present form be regarded as the final and most economical method of productivity.

(2) That in factory operations a higher education and intelligence is desirable.

Chapter IX.—That the wider capacity resulting from broader education and mental development would produce a greater flexibility in the application of labour, and would solve some of the frequently recurring problems of sectional unemployment.

Chapter X.—(1) That under an organised system of industrial training the personal objections now raised against higher education during works employment would be discounted.

(2) That the reduction of time during which a boy is actually producing does not necessarily render his whole apprenticeship period less valuable to the employer if the deducted time is utilised for training to higher efficiency.

ALLDAYS & ONIONS COMPANY, LIMITED, Great Western Works, Birmingham, have forwarded a copy of their illustrated catalogue, Section A, giving a list of "Anchor" vises, vise benches, anvils, smith's tools, etc. The list covers 60 pages and includes a comprehensive range of tools; it should be both useful and interesting to engineers and works' managers.

Points for Young Moulders.

Be sure there is enough metal in the ladle before pouring the job.

Learn how to calculate the quantity of metal required to cast your work.

Always allow for runners and risers about 25 per cent. above the quantity of metal required to fill the mould.

Do not guess the amount of metal required, it is dangerous, and is the cause of many wasters. It is usually left to the foreman to calculate the amount of metal required for each mould, but there is no reason why you should not learn to do it also, for some day a leading hand or foreman will be wanted, and you should be prepared to fill the place.

No man is fit for the position of foreman unless he knows how to calculate the metal required for a mould.

There is no time to learn after you get the position, so begin to learn at once and give up guessing.

Do not let metal set in the bottom of the ladle; it spoils the chances of the next job poured from that ladle.

A number of small runners are far better than one large one.

Study the job before deciding where it shall be run and where the riser shall be placed.

See that the metal has the clearest flow possible, when entering the mould at the runner.

Risers, or flowers, relieve the strain on the mould, and are convenient for feeding any heavy section of a casting.

Do not depend on a riser taking off any dirt; it does not do so. Be sure the mould is clean.

Be sure the metal is in the right condition for pouring the job; for it is possible to cast a mould too hot as well as too cold.

Castings for different purposes and of different design require different mixtures of metal and different treatment. Think of this, and be sure you are treating the job rightly.

Do not be wasteful in the use of the tools and materials supplied for your use. Your employer has to buy them, and the more he has to spend in this way, the less able will he be to give you an advance in wages.

Do not unnecessarily loosen patterns, for, not only will you loosen parts of the mould, but the pattern will probably suffer damage. All patterns will not stand the hammer.

Be sure that all clamps are sound and that you have enough weight on the job to resist the strain.

When you have once made a job successfully, do not vary the method of making it, as in doing so, you will be liable to make wasters.

Keep the mould joints clean, for a dirty or ragged joint is the forerunner of a run out and a possible waster.

Keep on good terms with the foreman if you wish to learn all branches of the trade.

Apprentices cannot afford to lose the goodwill or friendship of anyone in their shops.

A good apprentice will make a good journeyman.

Never allow yourself to think you have learned the entire moulder's trade, for one's knowledge can constantly be increased; no man has yet mastered the moulder's trade.

Always remember that it is to your advantage to be the best man in the shop.

Be at your work first thing in the morning. You may get a superior job on that account.

Ask the foreman when you are in doubt. Don't "chance it" The foreman is responsible.

Foundry Sands and their Treatment.

By Algernon Lewin Curtis, M.E.

(*Continued from page 456.*)

A Partial Study of Moulding Materials.

Before referring to the effects produced by crystals on transmitted light, as described in detail in the text-books, it may be of interest to give here a brief scheme of classification into systems of the optical determinations as outlined by Luquer. These are :—

Homogeneous.—The whole system shows the same optical character, except in the case of twin crystals, when the different portions of the twin are affected differently.

Isotropic.—All sections of the substance remain dark during a complete rotation between crossed nicols, and no interference figure is produced by convergent light.

Amorphous.—Absence of crystalline form or cleavage.

Isometric.—Presence of crystalline form or cleavage.

Anisotropic.—Sections generally show some interference colour and extinguish four times at 90 deg. apart during complete rotation.

Unaxial.—Determined by character of interference figures obtained by convergent light from sections which remain dark or nearly so during complete rotation. All sections show parallel or symmetrical extinction.

Tetragonal.—Sections giving interference figures are four- or eight-sided, or show rectangular cleavage.

Hexagonal.—Sections giving interference figures are three-, six-, and nine-sided, or show cleavage lines intersecting at 60 deg.

Biaxial.—Determined by character of interference figures obtained by convergent light.

Orthorhombic.—Extinction is parallel or symmetrical in all sections parallel to the crystallographic axes. Colour distribution is symmetrical to two lines, and to the central point.

Monoclinic.—Extinction is only parallel or symmetrical in sections parallel to the ortho axis; all other sections show extinction angles. Colour distribution is only symmetrical to one line or to the central point.

Triclinic.—Extinction angles in all sections, although in some minerals these angles may be very small. No symmetry in colour distribution.

Aggregate.—Not homogeneous, but made up of an aggregation of individuals, all extinguishing at different times.

The question of light is probably the next most important part of a microscopic examination of moulding materials, dark ground illumination being essential; and until Mr. Chas. E. Heath, F.R.M.S., brought out and perfected the incandescent gas lamp, shown in Fig. 6 (made by H. F. Angus & Company, 83, Wigmore Street, London), microscopists were much handicapped in making examinations of dark substances like old moulding sands. The extra power of this incandescent gas light is infinitely superior to an oil lamp (and electric light usually too difficult to obtain), as its white colour is very welcome, and the image can be made most brilliant, even if the object (in this case moulding materials) be somewhat dense.

A finely-ground glass in front to break down the mesh of mantle, then a pale cobalt glass in front of this (both glasses being slipped in the chimney) will whiten the light considerably, making it as near daylight as possible.

Other microscopic requirements are bottles of liquids of known refractive index, bottles of fluids of heavy liquids of known specific gravity, a separating funnel, and one or two beakers. According to Hatch and Rastall, the most important heavy liquids for use in making mineral separations

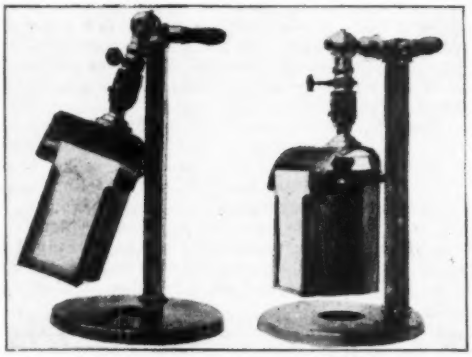


FIG. 6.—INCANDESCENT GAS LAMP.

are as follows, the liquids recommended for practical use being italicised :—

Liquid.	Density and melting point.	Price per ounce.	Authority.
		s. d.	
Bromoform	2.9	0 6	Hatch and Rastall.
Acetylene tetrabromide ..	3.0	1 3	,, ,,
Methylene iodide	3.33	3 6	,, ,,
Methylene iodide and iodine	13.6	Not given.	,, ,,
Dilution of the above liquids and washing of grains to be effected by means of benzene.			
		s. d.	
Mercury potassium iodide ..	3.17	1 5	Hatch and Rastall.
Cadmium borotungstate ..	3.28	2 2	,, ,,
Barium mercury iodide ..	3.5	1 8	,, ,,
		per pound.	
Mercurous nitrate .. .. (*crystalline*)	4.3-70° C.	3 4	,, ,,
		per ounce.	
Thallium silver nitrate ..	4.5-75° C.	7 4	,, ,,
Thallium mercury nitrate ..	5.3-76° C.	8 0	,, ,,

By using these liquid separations quantitatively, accurate separations of minerals can be made in many cases. Perhaps the most useful and agreeable to use are the organic liquids, *i.e.*, bromoform, acetylene tetrabromide, and methylene iodide. These being very mobile, they evaporate without leaving a residue, are non-corrosive and do not attack carbonates; also the readiness with which

grains can be washed after separation, the absence of residue on the grain, and the rapidity with which they dry are considerable practical advantages. For general use, and especially for the quantitative estimation of the total amount of heavier minerals present, bromoform, which is comparatively cheap and effective, can be strongly recommended. The great objection to methylene iodide is its expense, and though it tends to darken through the separation of iodine, it can be cleansed by shaking with a little potash and filtering. For any special use the density of methylene iodide can be increased to 3.6 by adding iodine, though the solution thus obtained has the disadvantage of being very dark coloured.

The corrosive action on the skin of a solution of mercury potassium iodide makes it objectionable. Cadmium borotungstate is rather viscid, has an acid reaction and crystallises out very readily; these are serious drawbacks to its use. Barium mercury iodide is rather unstable, and is not required if methylene iodide is used. Mercurous nitrate, thallium silver nitrate and mercury nitrate, unlike the previously-mentioned salts, are used in a state of fusion. On account of its cheapness, its lower melting point and its superior mobility, mercurous nitrate ($HgNO_3$, H_2O) should be used where possible.

FIG. 7.—SEPARATING FUNNEL.

A simple form of separating funnel, as shown in Fig. 7 (Messrs. Baird & Tatlock, Limited), is the best form of separator for use with media like bromoform which are liquid at ordinary temperatures,* and same can be adapted to meet all requirements. For general use with large amounts of moulding sand, it is convenient to use a funnel whose diameter is about 10 c.m. at the upper margin; the neck having an internal diameter of about 5 m.m. The bore of the glass stop-cock should be the same or nearly so as the diameter of the neck tube.

By means of such a funnel a large sample of sediment can have its proportion of heavier minerals (like quartz) quickly and quantatively estimated. The bromoform or other liquid used is first poured into the funnel, after which a weighed amount of dry moulding material is placed in it and thoroughly stirred, and the heavier minerals can then be drawn off by opening the stop-cock. If the proportion of heavy minerals is small as in the case with ordinary unconcentrated sediments, say about 100 grammes or so, can be added at once. When, however, the amount of heavier minerals is large, as in concentrated sediments, and in many crushed igneous rocks, the mixture should, if necessary, be added in several portions, the stop-cock being opened each time to prevent the accumulation of too much material in the neck of the funnel.

It is convenient to have the heavy-liquid bottle at hand provided with a filtering funnel fitted with filter paper, and to allow the heavy minerals to drop on to the filter paper. After the heavy liquid has drained off, the filter paper can be detached and opened, and the heavy grains washed off by placing the paper face downwards in a watch glass or porcelain dish containing benzene or distilled water, according to the heavy liquid used. The washings thus obtained can be kept in a separate bottle and used over again.

Ultimately, the amount of heavy liquid in the washings will become considerable and can be recovered if it is thought worth while. For a rough quantative separation of a small amount of moulding sand in bromoform, a small cylindrical and flat-bottomed specimen tube placed in a flat-bottomed porcelain dish can be used. Fill half the tube with bromoform, introduce the moulding sand and stir. Then add liquid until the tube is full, allowing the lighter grains to collect at the surface. By causing the liquid to flow down a glass rod into the tube the lighter minerals can be collected in the porcelain dish. A small amount of moulding material can often be quickly and effectively treated in this way, but wherever possible the use of the separating funnel is preferable.

Separation by means of liquid fusions, such as mercurous nitrate, is best made by using a test tube and fusing in a water bath or over a flame. After separation has been effected, the tube is allowed to cool, and broken so as to recover the solid mass, the fragments of test tube being carefully removed; then the solid column containing the separated minerals can be cut across near the ends, or in the middle if necessary, to obtain the separated grains.

To approximately determine the refractive indices, the Schroeder van der Kolk or Beche methods should be resorted to, and for this purpose a set of liquids of different refractive indices should be kept ready for use. The following are selected from Schroeder van der Kolk's list :—

Ethylene chloride	1.450	Monobrombenzol	1,561
Olive oil	1.469	Orthotoluidine	1.571
Benzol	1.501	Aniline	1.583
Cedarwood oil	1,505	Bromoform	1.590
Monochlorbenzol	1.523	Cinnamon oil	1.605
Ethylene bromide	1.536	α–Monochlornaphthalene	1.635
Clove oil	1.544	α–Monobromnaphthalene	1.655
Nitrotoluol	1.546	Methylene iodide	1,740
Nitrobenzol	1.552	Sulphur in methylene iodide	1.830
Dimethylandine	1.558		

Other refractive index powers are :—

Water	1.34	Almond oil	1.60
Alcohol	1.36	Cassia oil	1.63
Glycerine	1.41	Petroleum	1.457
Aniseed oil	1.58		

A complete set of 21 liquids in small bottles with refractive indices varying between 1.447 to 1.83 can be obtained from Dr. F. Krantz, Bonn, Germany.

The points to be considered in the identification of any mineral in moulding sands are its colour and pleochroism, refractive index, behaviour under crossed nicols, and specific gravity.

Colour and pleochroism can be seen by inspection; the refractive index is found by immersing grains in a fluid of known R.I. and then under the microscope by the Schroeder van der Kolk method, finding whether the R.I. of the grain is higher or lower than that of the liquid.

Under crossed nicols it will be seen whether the mineral grain is isotropic or not, whether its extinction is straight or at what angle it is inclined.

Specific gravity is found by putting the grains into a heavy liquid in the separating funnel, when those

* It might be of interest to state that a well known geologist and petrologist in communicating recently with the author, stated his inability to procure a suitable separating funnel in England, having to send to Germany for same.

grains with a heavier specific gravity than the liquid will fall to the bottom and can be drawn off.

The minerals in moulding sands which it is necessary for the foundryman to recognise under the microscope (since it is the inclusion of certain minerals in a moulding material which lowers its refractory qualities, hence causing bad castings) are as follows :—

Spinel.—This mineral is one of six varieties belonging to the Spinellid group of singly-refracting minerals. Composition, $Mg(AlO_2)_2$, Pleonaste (Fe, Mg spinel), Picotite (Cr. spinel). Generally aluminates of magnesium, iron, chromium, and other elements. Isotropic and isometric. No cleavage. Usually octahedral grains with rounded edges—see Fig. 8 Colourless to pink or green, sometimes brown. Refractive index, generally about 1.72 to 2,000 > α-monobromnaphthaline, and less than that, but near to methylene inodide. Found in gneiss and granulite, and in regions of contact metamorphism and secondary bedding formations (picotite), olivine basalt and serpentine. Insoluble in acids. Specific gravity, 3.5 to 4.1. Hardness, 0.8. Very refractory and occasionally found in moulding sands.

Fig. 8.—Spinel. Mag. × 20
(From Hatch & Rastall.)

Fig. 9.—Garnet in Mica Schist, showing Fracture.
(From Luquer & Cohen.)

Fig. 10.—Zircon.
Mag. × 20.
(From Hatch & Rastall.)

Garnet.—A single refracting mineral of seven varieties, isotropic and isometric. Composition, $R^{II}\ R^{III}\ (SiO_4)_3$. R^{II} is Ca, Mg, Fe or Mn. R^{III} is Al, Fe^{III} or Cr, rarely Ti). One kind is a silicate of lime and aluminium, another of lime and iron, another of magnesium and aluminium. Grains usually irregular, but sometimes faceted owing to an imperfect cleavage (110). Colourless to pale and deep red. Index of refraction, 1.750 to 1.856, high > methylene iodide. Usual appearance in sections as

Fig. 11.—Calcite
Mag. × 20.
(From Hatch & Rastall.)

Fig. 12.—Calcite
Section.
(From Luquer & Cohen.)

Fig. 13.—Apatite
Mag. × 20.
(From Hatch & Rastall.)

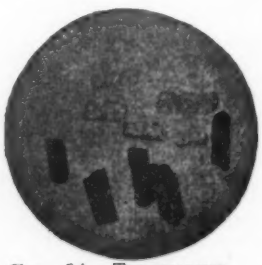


Fig. 14.—Tourmaline
Mag. × 20.
(From Hatch & Rastall.)

Fig. 15.—Sillimanite.
Mag. × 20.
(From Hatch & Rastall.)

irregular grains (see Fig. 9). Irregular cracks occur, but no cleavage noticed. Found principally in granulites, metamorphic rocks, contact rocks, crystalline schists, etc. Certain varieties may be found in eruptive rocks or olivine rocks. Garnets are practically insoluble in hydrochloric acid. Specific gravity, 3.4 to 4.3. Hardness, 6.5 to 7.5. Generally confined to sands from glacial drift, and fusing at low temperatures is not desirable in a moulding sand.

Rutile.—A doubly-refracting unaxial mineral, being an oxide of titanium TiO_2. Anisotropic and tetragonal. Prism (110), cleavage fairly good. Usual appearance, sharp, elongated, prismatic crystals when microscopic, but granular when the individuals are large. Index of refraction very high, 2.712, hence relief marked, and surface very rough. Pleochroism and strong absorption may be noticed, especially in the larger grains, but may fail entirely. In consequence of its refractive index, rutile though transparent shows the metallic type of lustre in reflected light, a characteristic feature of considerable value in the identification of its grains under the microscope. Found in the metamorphic schists, amphibolites, slates, contact fragmentary rocks, etc., also as inclusions in quartz and mica. Especially common as a secondary product of titaniferous hornblende and biotite. Insoluble in hydrochloric acid. Specific gravity, 4.2. Hardness, 6 to 6.5. Fairly refractory, fusing at 1,560 deg. Cent. Most moulding sands contain hair-like inclusions of rutile in their quartz grains. Yellow to brownish-red.

Zirkon (or Zircon).—A doubly-refracting unaxial mineral, being a silicate of zirkonia, $ZrSiO_4$. Anisotropic and tetragonal. Occurs usually in the form of well-defined small crystals, having elongated prism faces and pyramidal terminations (see Fig. 10). Usually colourless, but sometimes pale brownish. Index of refraction very high, 1.95; hence relief very high and surface rough; 1.95 > sulphur in methylene iodide. Found widely distributed, but not in any quantity, in eruptive and metamorphic rocks. Occurs in granite, syenite, diorite, gabbro, gneiss, etc. It is one of the oldest constituents of the rocks in which it occurs, and may often be found as inclusions in the ferromagnesium minerals. Specific gravity, 4.5 to 4.7 Hardness, 7.5. Insoluble in hydrochloric acid. Zircon being one of the first minerals to crystallise during the cooling of molten rock, it found as inclusions in quartz and felspar. Very refractory, only fusing at 1,900 deg. C.

Corundum.—A doubly-refracting unaxial mineral, Al_2O_3. Anisotropic and hexagonal. Appearance, pyromidal or prismatic crystals, grains or basal plates, usually irregular grains. Colourless to blue. Index of refraction very high, 1.76 > methylene iodide; hence relief well marked and surface very rough. Found in contact metamorphic rocks, eruptive rocks, and granular limestones. Insoluble in hydrochloric acid. Specific gravity, 3.9 to 4. Hardness, 9. Very refractory, but alters to muscovite and fuses at 1,230 deg. C. Rarely occurs in moulding sands.

Quartz.—A doubly-refracting unaxial mineral, being an oxide of silicon, SiO_2. Represents from 60 to 90 per cent. of the base of all moulding sands. Anisotropic and hexagonal. Colourless, although by reflected light it may appear coloured or cloudy if it contain many inclusions. Index of refraction low = 1.547 > ethylene bromide. Cleavage rarely noticed, an important fact in determining quartz, which breaks irregularly. Minute fluid, gas and mineral inclusions, often in irregular trains, are very characteristic of quartz in granite rocks and crystalline schists. Such inclusions are not so abundant in porphyritic rocks, but a few glass inclusions may occur filling up "negative" crystals in the quartz. Rutile, amphibole, etc., may occur as needle-like inclusions in quartz. Quartz occurs widely distributed, as in the great sandstone formations. It is also a characteristic mineral of all acidic rocks, being common in granite, aplite, rhyolite, "quartz-porphyry," "quartz-diorite," dacite, etc. Being very brittle, is a good indicator of the dynamic forces which have affected the rocks. Soluble in HFl only. Specific gravity, 2.6 to 2.7 Hardness, 7. Quartz, which is the last constituent of molten rocks to crystallise during cooling, changes under heat to tridymite at 800 deg. C., that mineral fusing at 1,600 deg. C.

Calcite, Dolomite and Magnesite are all double-refracting unaxial minerals of the spar group. Calcite is a carbonate of lime and an essential constituent of limestone, CaC_3. The Ca may be replaced by small quantities of Mg, Fe, Mn, etc. Anisotropic and hexagonal. Usual appearance as grains and aggregates, may be fibrous, and only in crystals in the granites of the central Alps. Cleavage parallel to unit rhombohedron (1011) appearing in thin sections as many sharp cracks Colourless when pure, but may appear coloured by transmitted light due to organic pigments. Index of refraction = 1.601 > but nearly = a. monobromnaphthaline. Fig. 11 shows calcite fragments in Canada Balsam × 20. Fig. 12 shows a calcite section. Calcite is very widely distributed in addition to the extensive sedimentary limestone deposits. It is easily attacked and completely dissolved with effervescence by cold dilute acids. Specific gravity, 2.72. Hardness, 3. Sometimes found in minute particles in moulding sands derived from glacial drift.

Dolomite.—Anisotropic, hexagonal. A carbonate of lime and magnesia. $(CaMg)CO_3$, when pure $CaO = 30.4$, $MgO = 21.7$, $CO_2 = 47.8$ Proportions of Mg and Ca vary; and Fe and Mn also occur. Usual appearance in rocks chiefly as crystals, even dense homogeneous aggregates showing tendency towards crystalline boundaries. Colourless. Index of refraction = 1.622, a little higher than that of calcite. The microscopic characters are similar to those of calcite, from which it may be distinguished by not being so easily attacked by cold dilute acid (test can be made on slide with cover off). Dolomite occurs in sedimentary formations and as crystals in limestone and other rocks. Only slightly attacked by cold dilute acids, but if heated, easily dissolves with effervescence. Occasionally found in moulding sands.

Apatite.—A doubly-refracting unaxial mineral, being a lime phosphate and fluoride $Ca_5(Cl.F)(PO_4)_3$. Usual appearance, minute, slender hexagonal prisms, cross-sections having regular hexagonal boundaries, needles and grains (see Fig. 13). Anisotropic and hexagonal. Generally colourless, and seldom bluish or brownish, even then only in eruptive rocks. Index of refraction = 1.635 > = moniodobenzol, hence relief more marked than that of the colourless associated minerals. Cleavage seldom observed microscopically. In parting long columnar crystals generally show a transverse jointing, so that the pieces may be more or less separated. Gas and fluid inclusions may be present. Found in most igneous rocks and crystalline schists. In the crystalline rocks it appears as one of the oldest secretions from the magna, and hence is often found as inclusions in other minerals, especially biotite, hornblende, etc. It is easily soluble in HCl and nitric acids. Specific gravity, 3.19. Hardness, 4.5 to 5. Apatite is widely distributed in moulding

sands in the form of dust and possess a medium refractory quality, fusing at 1,550 deg. C.

Tourmaline.—A doubly-refracting unaxial mineral, supposed to be a silicate of aluminium, lithium, manganese, lime and magnesium. $R_{18}B_2(SiO_3)_4$. R chiefly Al, K, Mn, Ca, Mg, Li. Usual appearance, staff-like individuals, bunched, or in radiating aggregates or prismatic crystals (see Fig. 14). Anisotropic and hexagonal. Varies greatly in colour from a green (most common) to a greyish-blue to brown. Index of refraction = 1.62 > = Cinnamon oil. Cleavage not seen in thin sections, but irregular, transverse and longitudinal cracks may appear. The black schorl is the only primary tourmaline, and is found in granitoid rocks. Tourmaline in other rocks results from "fumarole" action, hence occurs in pegamite, tin and copper veins, clay deposits, also in contact rocks, and crystalline schists. Tourmaline is not acted upon by acids. Specific gravity, 3 to 3.2. Hardness, 7 to 7.5. It can be separated from powdered rock by specific gravity solutions combined with magnetic methods. Very common in moulding sands and easily fuses.

Sillimanite $Al(AlO)SiO_5$.—Usual appearance, long, slender, colourless prisms or needles, often in felt-like aggregates. Crystals often bent (see Fig. 15). Index of refraction, high, 1.660, near to a. monobromnaphthalene, hence relief marked. Found especially in rich clay contact rocks, gneisses and schists. Crystals may appear in bands. Specific gravity, 3.24. Hardness, 6 to 7. Very refractory and sometimes found in moulding sands.

(To be continued.)

The Curtis Mould-Testing Instrument.

Next to correct metal and sand mixtures there is probably nothing so important in the foundry to secure first-class castings as the proper ramming of sand at the surface of a mould. In almost every case each moulder will adopt a different method for performing this work, though all are trying to obtain the correct pressures or densities which sand should be rammed in moulds to ensure good castings.

The above would seem to raise the question as to what is the correct density or pressure at which a mould's surface should be rammed. Experience provides an answer by referring to three general principles, viz :—

(1) The mixture and temperature of the molten metal.

(2) The head of metal and time taken to pour.

(3) The capacity of the sand mixture to hold moisture and be compressed, so as to get natural venting.

Some moulders think that the heavier the cast the more dense the mould should be; in other words, a heavy casting should have its surface rammed very hard. Such is not the case, however, for if the beds of all solid heavy castings were rammed very hard the moulds would generally be blown.

Therefore, instead of using the solidity, or weight, of a casting as a guide for determining the desirable hardness or density of the mould, it would be best to consider the time a head or pressure of molten metal is on the surface of such mould during pouring. As an illustrative proof that a hard-rammed surface of a mould is (except in certain cases) the cause of scabbed castings, let a pattern be bedded in the foundry floor by digging out a hole and shovelling in several feet of loose sand. Then remove the pattern and knock it into the soft sand until it appears solid. Such a method of bedding reverses the order of good work, for the simple reason that rapping down the pattern makes the surface of the sand hard, leaving soft sand immediately under it; this will cause molten metal, when first entering the mould, to bubble and scab the casting.

Two good points to be observed in founding are :—(*a*) That molten metal will not lie quietly on dense or damp sand; (*b*) that molten metal will exert a pressure according to the height of its head, the same as other fluid bodies. Mr. Algernon Lewin Curtis, Chatteris, R.S.O., had these principles in view when he designed the mould-testing instrument shown in Fig. 1. This instrument, which is made by Messrs. Baird & Tatlock (London), Limited, Hatton Garden, London, consists of a cylindrical tube with a detachable flange at its bottom for placing on the surface of a mould, and at the top of tube a screw cap or stuffing box for a piston stem to slide in.

Curtis Mould-testing Instrument.

Inside the cylindrical tube works a metal plunger, and a stem upon which is centred a piston, the bottom of the stem working inside the metal plunger, while above the piston it passes through the screw cap terminating in a handle. Between the top of the metal plunger and the bottom of the piston on the stem is fitted a spring, which can be deflected by exerting pressure on the handle at the top of the stem. The cylinder is provided with two vertical slots placed one above the other, the top slot having a scale calibrated in lbs. up to 25 lbs., the bottom slot having a scale calibrated in $\frac{1}{8}$ths of an inch up to 3 in. Over the surface of each slot work two index pointers fitted respectively to the top of the metal plunger and the piston at sliding stem, each pointer registering on its respective scale the pressure exerted on stem handle in pounds and depth of penetration of the metal plunger in inches.

To operate the instrument it is placed on the surface of a green-sand mould and the handle on the stem pressed downwards, carefully noting the pressure and travel of plunger on scales, until 1 in. of penetration has been obtained by the plunger in the mould. This should be recorded and compared with other moulds made by different workmen. Moulds showing different pressures can be tested with this instrument, and resultant castings examined to compare results, which will prove interesting. In order to make the instrument popular amongst foundries, Mr. Curtis has altered same, making it smaller and more portable, so that it can be conveniently carried in the pocket, besides making it capable of registering up to 56 lbs.

Convention of French Foundrymen's Association.

The Association Technique de Fonderie made a notable landmark in its history recently, when it held its annual Congress and the Foundry Exhibition in Paris. Considerable trouble was experienced in finding a suitable locality for the Congress, but at last authorisation was obtained to install the Congress and Exhibition at the Ecole Nationale d'Arts et Métiers, of Paris, not occupied at the present time, which was placed at the Association's disposal by the Director, Mr. Corre, who obtained the consent of the Minister of Commerce and Industry. Later the patronage of the Minister of Commerce was secured, as well as the authorisation of the Prefecture of the Seine.

The membership of the Association includes many prominent men associated with the foundry trade, scholars of various branches, and engineers, the number being now 320.

Among the notable subjects discussed at the Congress may be mentioned two Papers from the competition on the "Practical Study of Foundry Cupolas." The first Paper, by M. André Desquenne, mechanical engineer, Société Huta-Bankowa, Russia, was awarded a prize of 500 fcs. The second Paper was by M. Gueneau, a civil mining engineer and director of the Usines Salin. These Papers will be dealt with in a later issue.

The first sitting of the Congress was opened under the Honorary Presidency of M Corre, the Director of the Ecole Nationale d'Arts et Métiers, of Paris, deputy of the Minister of Commerce and Industry; M. Roger, first Vice-President of the Association Technique de Fonderie, conducting the discussions. At the adjournment of the first sitting the Exhibition was officially opened by the Honorary President, the President, and the members of the Committee.

During the afternoon session, which opened at 2 p.m., the discussion on "The Practical Study of Foundry Cupolas" was ended. This discussion brought forward numerous interesting points. Thereafter followed the discussion of M. Gueneau's Paper on "The Numerical Classification of Cast Iron, its Insufficiency: Chemical Classification." Numerous opinions were expressed on the subject in the course of the discussion. Time did not permit of discussion of the whole of Mr. Curtis's Paper on "Foundry Sands and Their Treatment," but this interesting question will be revived and discussed at a future Convention.

The morning sitting on Wednesday, May 28, was opened under the presidency of M. Roger, and was devoted to the discussions of the Papers of General Cubillo, M. W. H. Hatfield, and M. Brasseur. The afternoon was left free to enable the members to visit the Exhibition.

In the morning of May 29, the session opened under the Presidency of M. Poinsat, and was devoted to the discussion of the Papers delivered by Messrs. Portevin, Lane, and Dawkins. Mr. Dawkin's Paper narrating a foundrymen's adventures in the most northerly of British foundries, was illustrated by pictures showing the ingenuity that Mr. Dawkins had to display in carrying out his work as a foundryman, and without tool equipment. This Paper was much appreciated on account of its humorous character.

In the afternoon of Thursday, May 29, the sitting was successively presided over by M.M. Poinsat and Bonnivert, and Papers by M. Lambot, Dr. Rosenhain, and M. Goupon weer discussed. The Congress ended with the discussion of the two rewarded Papers of M. Lamoureux, sent in for the competition on "The Study of the Small Incidents Occurring in Moulds." It may be said in this connection that 14 Papers were submitted, many of which presented considerable interest.

In the evening of Thursday, May 29, after the closing of the Congress, a banquet was held at the Orsay Palace, under the presidency of M. Corre, deputy of the Minister of Commerce and Industry. On Friday, May 30, an excursion was made to the Usine du Familistère de Guise, 70 members joining the party. The famous machines which have been working for nearly 30 years greatly impressed the foreign visitors, as well as many of the Frenchmen who were not familiar with them. The following day the members were divided between the various excursions provided on the programme, and the visit to the Exhibition.

The Exhibition attracted a considerable number of visitors. On the closing day, June 1, alone there were 1,200 visitors, the total number being about 3,000. Most of the machines were in operation, and also the furnaces and anyone interested in the subsubject had an excellent opportunity for study.

The organisation of the Congress was in every way most thoughtfully and efficiently carried out, and added greatly to the success of the function.

German Foundrymen's Association.

At the annual meeting of the German Foundrymen's Association held in Berlin on May 14 to 17 last, the Presidential address, delivered by Direktor Dahl, Berlin, reviewed the development of Germany's coal and iron trades during the past 25 years, together with the progress made by the electrical and foundry industries during that period.

In his Paper on "The Application of Surface Combustion in Foundry and Melting Operations," Herr Schnabel, Berlin, dealt with the researches of himself and Bone, which have enabled gaseous fuel to be utilised, with an efficiency of 93 per cent. in steam raising. Herr F. Goltze, Berlin, took for his subject "The Use of Cast Iron and Cast Steel in Electrical Engineering," and recommended silicon steel in preference to manganese steel, on account of its superior magnetic properties. Annealing, too, improves the structure and mechanical properties, and has a considerable effect on the magnetic properties, 750 deg. reducing these very slightly, and 1,000 deg. giving a marked improvement, though 900 deg. has a decidedly adverse influence. Coarseness of grain is found to be associated with good magnetic properties. In the case of cast iron, a small addition of aluminium has a beneficial effect.

"The Utility of Permanent Moulds in Iron and Metal Founding," was discussed by Direktor Mehrtens, Charlottenburg, who described the methods proposed by Kurze, Rolle and Custer, and mentioned

that the Rolle method had proved successful in a large foundry. In the case of ingot moulds for steel, he recommended best hematite as the most suitable material, with less than 0.1 of phosphorus and sulphur, such moulds being able to stand up to 250 pourings. Moulds which will stand up to 500 pourings can also be made from charcoal pig-iron with 1.3 per cent. silicon, 1.2 per cent. manganese, 0.15 per cent. phosphorus, and 0.06 per cent. sulphur. Permanent moulds can be satisfactorily used for red brass, bronze and aluminium, the physical properties of the castings being specially good, and the tensile strength, in particular, superior to that of metal cast in dry- or green-sand moulds.

Herr C. Cramer, Berlin, read a Paper on "Electric and Autogenous Welding in Foundry Work," with a sketch of the various processes. For cutting grey cast iron, he gave preference to the electric process, whereas the autogenous system is best for steel castings and wrought iron. "Progress in the Use of Briquette Iron for High-quality Cast Steel" formed the subject of a Paper by Herr E. A. Schott, Wittenberge, who recommended briquetted turnings on account of their low carbon content and consequent favourable influence on compactness of structure. In the cupola briquetted turnings should be placed directly on the coke charge, whereas cast briquettes should be put in last of all. There is no reason to assume that the use of briquettes gives slags specially rich in iron. Experience has shown that briquettes of steel and metal must be of smaller size than those of cast scrap if the same advantages are to be secured in both cases; and also that with good coke and proper working, the tendency of briquetted iron to absorb sulphur can be obviated.

In a Paper on "The Use of Coal-Tar Oil in Foundry Work," Herr R. Hausenfelder, Essen, sketched the rise of this oil as a fuel, and described the method of production in cokeries and gas works, together with the different types of burner introduced for utilising the oil. Its chief application up to the present in the steel industry is in crucible and melting furnaces; but it is largely used in metal foundries and for melting various metals. The fuel consumption in a 3 to 6-cwt. furnace for melting copper, bronze or red brass, is about 12 to 15 per cent. the weight of the charge, and about 6 cwts. of metal can be poured per hour. In larger furnaces, of 12 cwts. to 1½ tons capacity, the consumption falls to 8 or 10 per cent. in the case of bronze or red brass, and to 10 to 12 per cent. for copper, with a production of 10 to 14 cwts. per hour. For iron and steel, the fuel consumption ranges from 20 to 25 per cent. with grey cast iron to 40 to 50 per cent. for steel. Ferro-manganese can be melted down at the rate of 4 cwts. per hour from an 8-cwt. charge, with a consumption of 30 to 35 per cent. of oil, the loss of manganese being 4 to 5 per cent.

"Rational Melting and Pouring in Metal Founding" was dealt with by Herr K. Hunger, Berlin, who recommended covering the surface of the molten metal with reducing agents, in order to prevent oxidation and give a maximum fluidity for pouring. In the case of alloys, the stresses set up by shrinkage during cooling are best counteracted by increasing the strength by using a low pouring temperature or giving a very small addition of another metal. Furnaces, whether heated with coke or oil, give the best results when the metal of the charge is not brought into contact with the heating flame. The electric furnace also furnishes good metal, but is too costly for general use.

In speaking of "The Importance of Coal Dust in the Foundry," Herr E. A. Schott, Wittenberge, referred to the adverse influence of high ash content and large percentage of non-volatile constituents. As regards charcoal, the best form for use in the foundry is that made in heaps, this being the richest in carbon.

"Electric Moulding Machines" formed the text of Herr U. Lohse's Paper, the author preferring this type of the portability of the moulding apparatus, the economy of operation and the convenience of electricity as a source of energy. The various styles of machines were reviewed, and diagrams were exhibited showing the very low consumption of current and consequent low running expenses of electric moulding machines.

The "Schoop" method of spraying metal, and the possibilities of its application in foundry work was described by the inventor, Herr E. U. Schoop, Zürich. The process is asserted to be highly suitable for coating metal castings with a rust-proof layer of tin or zinc, and also for facing metals with lead, and lining brewers' trade casks with aluminium. A modification of the process enables detachable coatings of metal to be produced, especially in the case of metals more or less unsuitable for casting on account of their high affinity for gases, which they take up avidly from the atmosphere while molten, and expel on re-cooling, such metals being copper, nickel and certain nickel alloys.

Accidents in Iron and Steel Foundries.

The Report for 1912 of the Chief Inspector of Factories and Workshops includes statistics relating to accidents in iron and steel foundries. The following tables show the particular occupation in which they occurred, and the cause :—

Reported to Certifying Surgeons.

Causation.	Occupation.		Total.
	Moulders.	Others.	
Molten metal—			
Tapping	13	94	107
Catching	265	90	355
Pouring	470	127	597
Escape from ladles, bogies, moulds, &c.	852	384	1,236
Damp ladles, moulds, &c. ..	120	63	183
Miscellaneous	39	40	79
Lifting gear	58	109	167
Escape of steam, gas	3	14	17
Grinding, polishing machines ..	4	117	121
Other machines	8	87	95
Miscellaneous	16	72	88
	1,848	1,197	3,045

Reported to Inspectors only.

Causation.	Occupation.		Total.
	Moulders.	Others.	
Hand-worked lifting gear.. ..	22	69	91
Caught between two objects ..	129	270	399
Contact with sharp substance ..	100	179	279
Falls	100	232	332
Falling bodies	198	554	752
Struck by tool in use	25	81	106
Miscellaneous	429	773	1,202
	1,003	2,158	3,161

Other tables show that the majority of accidents occurred to operatives between the ages of 25 and 29.

Artificial Lighting of Iron Foundries.

The Annual Report of the Chief Inspector of Factories and Workshops for 1912 contains a Special Report upon the "Artificial Lighting of Iron Foundries," by Mr. D. R. Wilson, compiled as the result of visits to forty foundries in different parts of the Kingdom. Mr. Wilson expresses the opinion that so far as the actual carrying on of the work is concerned, the intensity of the illumination appears to be of little importance. At the moment of pouring ample light is derived from the molten metal itself, and the previous and subsequent processes can be and often are carried out with the aid of supplementary light obtained from portable lamps. Insufficient light is undesirable from the point of view of accidents, caused by stumbling during the passage from one part of the foundry to another, especially when handling metal or when passing near moulding pits or parts of the foundry in which metal has been recently poured. In other words, "general" rather than "local" illumination seems to be the important matter to be considered.

General Characteristics.

From the point of view of lighting, an iron foundry possesses several characteristics which are either absent or less pronounced in other works:—

(1) The whole of the floor space is covered with very dull and dark material. Measurements of the diffused reflecting power of this surface indicate that only about 2 to 3 per cent. of the incident light is reflected.*

(2) The material covering the floor is of uniform colour, and there is almost complete lack of contrast throughout the room. There is, therefore, no surface to serve as a contrasting background for obstacles, which are often difficult to distinguish.

(3) The processes involve the production of much dust, and at certain stages of the work dense smoke is evolved.

(4) Shadows are said to be specially undesirable, probably on account of the further reduction of the illumination.

(5) Glare is liable to result from the molten metal (and sometimes from badly shaded light sources placed too low) with the consequence that the eye is temporarily dazzled, and risk of stumbling is increased.

From the foregoing remarks it will be seen that for efficient lighting the illumination in iron foundries should be high compared with other rooms. Objects of similar and very low diffused reflecting power are the more readily distinguishable the more intense the illumination received by them, since contrast is enhanced by the increased difference in the amounts of light reflected. More efficient contrast could also be obtained, especially in small foundries, by frequent limewashing of the walls, the white surface of which would then serve as a background for the dark coloured objects on the floor. In addition to this advantage, a white wall does much to increase the actual illumination, especially with natural lighting. The walls in many foundries are already limewashed, but they are often almost black owing to the deposit of dust. The presence of smoke in any quantity greatly reduces the illumination on the floor, especially when the light sources are situated high up. This is, generally speaking, only a temporary matter, since the smoke soon makes its escape from the room, but it constitutes one more argument in favour of as intense an illumination as possible.

Dust, according to the report, has a more permanent deleterious effect in foundries where incandescent gas is the illuminant, since it is said to injure the mantles and to block the air orifices. On the other hand, it was found that incandescent gas systems are frequently adopted, and if suitable precautions are taken (such as protection of the mantles by glass shades, use of powerful units placed high, etc.), this method of lighting appears to give complete satisfaction, and is very efficacious as regards illumination. Dust also quickly destroys the whiteness of the walls by settling on them. This can be obviated, at any rate to some extent, by brushing down at frequent intervals. The dazzling effect of the molten metal is of course unavoidable, and is more or less temporary. Glare from high intensity light sources has been noticed occasionally owing to their being placed too low.

Shadow is said to be specially undesirable, as tending to confuse the eye and as reducing the illumination. In considering shadow, three points are of importance, namely, position, extent, and depth. The position of a shadow is determined by the position of the responsible light source. The latter should of course be placed in the locality in which the shadow is undesirable. The extent of the shadow depends on the height of the light source; the greater the height the shorter the shadow. The depth depends on the presence or absence of neighbouring light sources, or, in other words, on the evenness or unevenness of the illumination. For this reason, for the lighting of a given area, it is preferable to have two sources of, say, 1,000 candle power each, rather than a single source of 2,000 candle power. It would appear that the most satisfactory method of lighting is by means of powerful units, fixed as high as possible above the floor and spaced comparatively close together. Tables given in the report show that this method is adopted in most of the foundries classified as well lighted.

Results of Observations.

The results of observations show that a sharp distinction may be drawn between well- and badly-lighted foundries. In some of the former the very high minimum value of 1.5 foot-candles is attained and even exceeded, and the lighting may be considered good if the illumination does not fall below 0.5 foot-candle. In the badly-lighted foundries, in almost all instances, the system of lighting consists of ordinary flat-flame burners. In addition to their feeble intensity, these have other disadvantages. They are of necessity placed low down and in contrast with their dark surroundings tend to dazzle the eye; they are also liable to flicker unpleasantly and to cause confusing shadows, and are uneconomical from the point of view of gas consumption. Only one foundry lighted in this way could be described as even moderately well lighted; the others vary from poor to very bad. The actual data indicate the extremely bad lighting that exists in some of these foundries, measurements as low as one sixtieth of a foot-candle being recorded. Some idea of this deficiency may be given when it is remembered that the minimum illumination in a poorly-lighted subur-

* This refers to *Iron* foundries only. In *Steel* foundries a light coloured sand is used, and the diffused reflecting power is about 10 per cent.

ban street is about 1-100th of a foot-candle. It is probably impossible to secure really efficient lighting with the old-fashioned gas jets, and these should be replaced by some modern high-intensity system under expert advice, whereby not only would the illumination be greatly increased, but a large saving in the amount of gas consumed would follow. The investigation appears to show that the illumination received on a horizontal plane one foot above the floor level in :—

Well lighted iron foundries does not fall below 0.5 foot-candle.
Fairly " " " " " " " 0.3—0.4 " "
Moderately " " " " " " " 0 2—0.3 " "
Poorly " " " " " " " 0.1—0.2 " "
Badly " " " " " is below 0.1 " "

It would seem therefore that the lighting cannot be deemed to be adequate unless the illumination received on a horizontal plane one foot above the floor level is not less than one third of a foot-candle over any part in which work is being carried on or over which any person is liable to pass.

RESULTS OF OBSERVATIONS.

TABLE A.—WELL LIGHTED FOUNDRIES.

Index No.	Class of Work.	Floor Space (sq. ft.)	Means of Lighting. Kind.	Number.	Candle Power.	Height (feet).	Distance Apart. Between units in same Row.	Between Rows.	Quality of Illumination.	General Description of Lighting Arrangements.	Illumination (Foot-candles). Maximum.	Minimum (normal).	Minimum (actual).
(1.)	(2)	(3)	(4.)	(5.)	(6.)	(7.)	(8.)	(9.)	(10.)	(11.)	(12.)	(13.)	(14.)
1	Heavy ...	51,200	Flame arcs ..	32	3,000	14	40	40	Excellent	Four bays with 8 arcs in each, spaced opposite each other. Lighting uniform and very good.	3·9	1·5	—
2	Tubes ...	8,760	Flame arcs ..	3	4,000	—	22	8½	Excellent	Three arcs (one movable on crane) in centre row ..	1·2	0·8	—
			Metal filament electric lamps	12	150	—	—	—	—	The side bays are lighted by groups of three 50 c.p metallic filament glow lamps.	1·7	0·92	—
3a	Heavy ...	9,600	Flame arcs ..	2	2,000	22	50	20	Excellent	Two 2,000-c.p. flame arcs in centre row, on either side a row of 1,000 c.p. flame arcs. Sides lighted by 150-c.p. electric lamps.	2·2	1·6	—
			" " ..	8	1,000	11	30	20	—				
			Metal filament electric lamps.	8	150	13	30	20	—				
3b	Heavy ..	15,980	Flame arcs ...	4	2,000	18	34	31½	Excellent	A row of 1,000-c.p. arcs down centre. On one side a row of 2,000-c.p. arcs; on the other a row of 80-c.p. electric lamps.	2·2	1·6	—
			" "	8	1,000	18	34	31½	—				
			Metal filament electric lamps.	11	80	9	14½	31½	—				
4	Medium ...	10,260	Inverted arcs ...	11	?	12	45	19	Excellent	Inverted arc lamps are fixed to pillars by brackets which can be moved horizontally so as to serve any desired point within a semicircle of 12 feet radius. The diffused light prevents the formation of shadows.	6·5	0·4*	—
5	Light ...	3,840	Arc lamps (ordinary).	4	?	10-15	50	30	" ...	Two rows of two arc lamps, spaced alternately. Illumination in main foundry good and uniform, but an adjacent extension is very badly lighted by a single flare lamp, pending the installation of arcs.	5.0	1·7	0·09 to 0·024
6a	Heavy ...	11,700	Arc lamps (ordinary).	10	?	30	26	—	" ...	A large foundry well lighted by a single row of lofty arcs down centre; at one end additional arcs are fixed to the wall. Illumination is very uniform, and the great height of the light sources tends to prevent shadows.	2·2	1·8	—
6b	Pipes ...	3,080	Metallic filament glow lamps.	7	150?	12½	17 to	25	Good ...	A smaller foundry well lighted by metallic filament lamps with reflectors, spaced at varying distances.	1·8	0·88	0·46
7a	Light ...	2,850	Arc lamps (ordinary).	4	?	29	12	—	" ..	Well and uniformly lighted by a single row of arc lamps placed down centre.	0·53	0·50	—
7b	" ...	2,800	" "	3	?	17	23	—	" ..	Well lighted (except in one corner) by a single row of arc lamps placed down centre.	0·80	0·46	0·082
8	Heavy ...	126,600	Flame arcs ..	91	3,780	17-22	43	64½	Excellent	A very large foundry lighted throughout by flame arc lamps in seven rows. The illumination is very uniform.	2·8	1·8	—
9	Bedsteads	3,283	High pressure gas (inverted).	8	200	9	9	17	Good ..	The main foundry is well lighted by two rows of high pressure gas lamps. A gallery extends along one side, and under this the illumination is poor.	1·4	0·88	0·26
10	Light ..	1,440	Three-mantle incandescent gas (inverted).	2	1,500?	8½	25	—	Fair ...	A small foundry lighted by two composite incandescent gas lamps, each containing three mantles. Some of the mantles are in poor condition.	1·8	0·35	—
11a	" ...	21,600	Arcs (ordinary)...	16	?	20	40	30	Good ...	Foundry divided into six bays, each containing three arc lamps (some in poor condition) spaced "alternately" in each bay.	1·4	0·46	—
			Arcs (flame) .	2	?	20	40	30	—	One bay containing two flame arcs is specially well lighted.	2·0	1·6	—
11b	Heavy ...	4,500	Arcs (ordinary)—	11	?	14	20	15	Very fair	Arc lamps are spaced along one side and half-way along the other, and one arc is fixed at each end. Lighting rather uneven in part where there is a single row of arcs.	1 4	0·40	—
12	" ...	7,000	Flame arcs ...	4	1,800	26	40	35	Good ...	Arc lamps arranged symmetrically throughout. One Osram lamp fixed in corner for bench work. At the time of observation there was much smoke, so that the results are abnormally low.	1·4	0·23	—
			Metallic glow lamp.	1	600	11	—	—					
13	" ...	4,170	Arcs (ordinary)...	6	?	10	15	—	Fair ...	The lamps (an old-fashioned type of arc) are arranged in a single row down the centre, the sixth lamp being in one corner. They are practically unshaded, and being placed very low (10 feet) they are liable to cause glare and to dazzle the eyes of persons moving about. Portable lamps are used by the moulders.	3·6	0·26	—
14	Light ...	3,880	3-mantle incandescent gas (inverted).	4	1,500	26	34	—	Very good	A long narrow shop provided with a single row of 3-mantle inverted incandescent gas lamps in good condition and fixed high up.	1·8	0·7	0·36
15a	Heavy ..	6,000	Arcs (ordinary)...	4	600	25	50	—	Good ...	The foundry is lighted by a single row of ordinary arcs spaced down centre.	5·0	0·66	—
15b	" ..	7,000	Metallic filament glow lamps.	8	?150	10	30	—	Fair ...	The lamps are spaced in a single row down centre. An annex to the above	3·2	0·40	—
15c	Light ...	3,150	" "	4	?150	16	30	—	" ...	The lamps are arranged in a single row in centre ...	2·2	0·38	—
16a	Heavy ...	9,400	Flame arcs ...	3	1,000	30	55	—	Good ...	The main foundry is well lighted by a single row of flame arcs with metallic filament lamps in corners. An annex is less well lighted by gas-jets aided by light borrowed from main foundry. (Col. 14).	5·9	0·58	0·28
			Metallic filament glow lamps.	2	2,500	?	—	—					
			Gas-jets ...	3	?	5½	—	—					
16b	" ...	4,000	Arcs (ordinary)..	2	1,000	12	20-30	—	Excellent	The lamps are arranged irregularly in foundry ...	2·0	1·4	—
				2	500	—	—	—					
				2	250	—	—	—					
16c	Steel ...	5,600	Flame arcs ..	3	1,000	28	60	—	"	The lamps are arranged in a single row down centre...	2·7	1·9	—

* This minimum is temporary only, it varies with the position of the movable light source.

Hints for Young Pattern-Makers.

Be proud of your craftsmanship, prouder still of your craft; and uphold the dignity of both.

"Tearing it off," is the indulgence of the exceedingly skilful, or the very foolish.

"The race to the swift, to the victor the crown." True! but in pattern-making swift races should not be entered until the training is perfect and the practice sure.

Ambition begets perseverance; but should be leavened by reason.

Method is the first cousin of efficiency.

To read a drawing is, for a pattern-maker, *not* sufficient, he must visualise it.

A slave to custom can never be the servant of progress.

A "lagged-up" job saves weight and material; also if well made is as desirable as a solid pattern.

Circular end blocks for lagging allow any width of material to be used, but this advantage is offset by the more expensive circular fitting of the lags to the end blocks.

Polygonal end blocks require material of equal widths, but are an advantage as the joints, being flat, are more quickly formed.

Polygonal end blocks should be worked altogether, as one whole. This keeps all the flats and angles in perfect alignment.

Because wood is common it does not follow that it is cheap.

A *plank* in hardwood is any "stuff" upwards of 9 in. wide and 1¾ in. thick. In softwood, upwards of 10 in. wide and 2 in. thick.

A *board* is less than 2 in. in thickness, but over 6 in. in width.

A *batten* is between 1½ in. and 2 in. in thickness but less than 9 in. in width.

A *deal* is over 2¼ in. thick; but less than 10 in. in width.

Quartering runs from 3 in. by 3 in. up to 4½ in. by 4 in.

Quartered planks are planks cut radially to avoid "casting" and although the most costly form of timber, they are the most economical for forming standard patterns.

Looking and seeing are both distinct and different. You "look" with the eye, but "*see*" with the brain; make sure you see through the drawing before you start the job.

The setting out of a job need not be a picture; but it must be a neat accurate *working* drawing.

All lines in a setting out should be scribed, not pencilled; the latter are easily erasable, and being of vague and varying thicknesses are not conducive to accuracy or permanency.

Work to the dimensions given on a drawing, not to the scale. Print paper shrinks, and while a draftsman need only be "near enough," your work must be "*It*."

TABLE B.—BADLY LIGHTED FOUNDRIES

Index No.	Class of Work	Floor Space (sq. ft.)	Means of Lighting: Kind.	Number.	Candle Power	Height (feet)	Distance Apart: Between units in same Row	Distance Apart: Between Rows.	Quality of Illumination.	General Description of Lighting Arrangements.	Illumination (Foot-candles): Maximum.	Minimum (normal).	Minimum (actual)
(1.)	(2.)	(3.)	(4.)	(5.)	(6.)	(7.)	(8.)	(9.)	(10.)	(11.)	(12.)	(13.)	(14.)
17	Bedsteads	7,400	Upright incandescent.	3	?	7½	30	—	Poor ...	Gas jets placed irregularly throughout. The system is about to be changed, and experiments are being made with clusters of electric glow lamps under wide reflectors. The high vertical moulds tend to cause shadows.	0·64	0·17	—
			Ordinary gas ...	10	?	5–6	Varies.		—				
18a	Light ...	6,050	„ „ ...	46	?	5	Varies.		Bad ...	Lighted at one end by groups of four gas jets seven feet high and 12 feet to 17 feet apart. The other part lighted solely by movable gas jets on benches.	0·12	0·04	—
18b	„ ...	11,080	„ „ ...	60	?	6	18½	10–17	Very poor	Lighted by five rows of double gas brackets.	0·62	0·10	—
19	„ ...	6,080	Ordinary gas (groups of 9 jets).	5	?	20	22	—	Poor ...	One part is lighted by a row of groups of 9 gas jets 20 feet from ground. The other part by double gas brackets and jets on benches.	1·0	0·20	—
			Single gas jets ...	31	?	6½	11	12½	—		0·32	0·30	—
20	„ ...	3,630	Ordinary gas jets	—	?	6½	10	18½	Poor ...	A small foundry lighted by double gas pendants arranged in two rows.	0·65	0·16	—
21a	Hardware	1,480	Ordinary gas-jets	9	?	4	Varies.		Very bad	Small foundries very badly lighted by gas jets placed irregularly on benches.	0·74	0·038	—
21b	„	635	„ „	4	?	3½	Varies.		„ „		0·40	0·030	—
21c	„	2,340	„ „	11	?	4	8	Varies	„ „		0·20	0·048	—
21d	„	1,910	„ „	18	?	4	6	Varies	„ „		0·24	0·094	—
21e	„	500	„ „	3	?	4	Varies.		„ „		0·46	0·042	—
22a	„	2,430	„ „	10	?	4½	8	Varies	„ „	A small foundry badly lighted by gas jets arranged along wall, and one group of gas jets in centre.	0·66	0·018	—
22b	„	3,800	„ „	9	?	4½	Varies.		„ „	A small foundry lighted by gas-jets irregularly arranged.	0·35	0·016	—
23	Light ...	2,080	„ „	4	?	10	Varies.		„ „	A small foundry lighted by gas-lamps of various types placed irregularly. The mantles of the incandescent lamps are in poor condition, and, being unshaded, are liable to cause "glare." Not lime-washed.	0·28	0·04	—
			Incand. (upright)	2	?	10							
			„ (inverted)	2	?	10							
24	„	1,500	Ordinary gas-jets	9	?	8	Varies.		Moderate	An old ramshackle shop with large batswing-burners placed irregularly. The illumination is not very low, but the lights flicker and are generally unpleasant. Not lime-washed.	0·64	0·22	—
24b	„	1,060	„ „	6	?	4	13	24	Very poor	Rows of single gas-jets along each side of shop. One jet broken off. Not lime-washed.	0·20	0·064	—
25a	Pipes ...	47,520	„ „	130	?	3½–6½	10–18	About 30.	Poor ...	A very large foundry poorly lighted with gas-jets placed irregularly. Only a small part of the shop was lighted at the time of visit.	0·16	0·032	—
25b	„ ...	9,900	„ „	38	?	6	10–20	Varies	„ ...	A smaller foundry lighted by double gas-brackets irregularly arranged.	0·24	0·058	0·05
26a	„ ...	24,700	„ „	95	?	5–6	15	„	Bad ...	A large foundry lighted by rows of double gas-brackets placed irregularly.	0·26	0·06	—
26b	Medium ...	4,500	„ „	6	?	3½	22	50	Very bad...	A small foundry lighted by a row of single gas-brackets on each side wall. The travelling crane is said to be a difficulty in the way of improving the illumination.	0·07	0·02	—

The Influence of Silicon on the Corrosion of Cast Iron.*

By J. Newton Friend and C. W. Marshall (Worcester).

Owing to its relatively low melting point, the ease with which objects may be cast from it, and their extreme hardness when completed, cast iron is now being used for commercial purposes in ever-increasing quantities. It is eminently desirable, therefore, in view of the serious nature of the corroding influences to which articles are exposed, to determine what the influence of varying constituents may be on the corrodibility of cast iron, and to learn what particular compositions offer the maximum resistance to corrosion.

Hitherto but little work has been done in this connection, which affords a wide field for research, inasmuch as the chemical composition of cast iron and the physical conditions at the time of experiment, admit of enormous variation. The problems are in consequence proportionately complicated, and a vast amount of work remains to be done before generalisations of any real value can be made. In the present Paper the authors give the results of a study of the influence of silicon upon the corrodibility of cast iron.

For many years chemists have recognised that the presence of alloyed silicon tends to retard the corrosion of iron. Thus Mallet** more than seventy years ago was aware that cast iron rich in silicon is less readily attacked by acids, and Jouve† has recently proved that alloys of silicon and iron containing 20 per cent. of the former element are remarkably resistant to acid attack. But alloys such as these are not cast iron, and their utility is greatly restricted by the difficulty of working them on account of the peculiar properties imparted to them by the silicon.

The authors have therefore confined their attention to the influence of corrodibility exerted by a silicon content varying from 1.24 to 2.28 per cent. They would gladly have extended this series had it been possible, but the advantage of studying this particular range is twofold:—(1) It covers many of the various silicon contents usually met with in commercial cast irons, and the results are not therefore of purely scientific interest. (2) The silicon is never so great as to interfere with the nature of the carbon content.

The latter is a most important point, and one to which we hope it may be possible to give further attention at a later date. As is well known, the presence of silicon tends to throw out the carbon as graphite, thereby rendering the metal porous and more liable to corrosion. Consequently, unless particular care be taken to keep the carbon in the same condition, both physically and chemically, the influence of the silicon *per se* upon the corrodibility of the metal must be affected by the proportion of graphitic carbon, and the results rendered misleading. The various cast irons used in this research were especially prepared for the authors by Messrs. Green & Company, of Wakefield, and they have pleasure in acknowledging their indebtedness to the manager, Mr. W. B. Greener, for his kindness. The irons were cut into blocks measuring 4.8 × 1.1 × 1.5 cubic centimetres, and, after rubbing with emery paper, were tested in this form. The authors wish also to thank Mr. A. E. Page, chemist to Messrs. Green & Company, for kindly analysing the metals for them. The results of these analyses were as in Table I.:—

* Paper presented before the Iron and Steel Institute.
** *British Association Reports*, 1838, p. 277.
† *Journal of the Iron and Steel Institute*, 1908, No. III., p. 310.

TABLE I.

Cast iron No.	Percentage Composition.					
	Silicon.	Graphite.	Combined carbon	Manganese.	Sulphur.	Phosphorus.
1	1.24	2.70	0.65	0.63	0.096	0.99
2	1.29	2.65	0.68	0.75	0.093	1.05
3	1.45	2.55	0.65	0.89	0.082	1.04
4	1.55	2.70	0.67	0.86	0.079	1.02
5	1.72	2.75	0.61	0.75	0.085	1.06
6	2.04	2.60	0.51	0.86	0.115	1.09
7	2.28	2.75	0.55	0.69	0.076	1.04

It will be observed that, with the exception of the silicon, the other elements are present in the cast iron in remarkably uniform proportions. The corrosion of the samples containing the lowest quantity of silicon (No. 1) is in all the accompanying series taken as 100, the corrodibilities of the other samples being expressed accordingly.

I.—Tap Water Tests.

The samples of iron were laid on sheets of paraffin wax in glass beakers containing 500 cubic centimetres of tap water. After seventeen weeks the irons were removed carefully scraped free from rust, rinsed in alcohol, and dried in a steam oven. They were then weighed, the loss in weight being taken as a measure of the corrosion (see Table II.).

TABLE II.—*Corrosion of Cast Iron in Tap Water* (17 *Weeks Exposure*).

Cast iron No.	Silicon. Per cent.	Original weight. Grammes.	Loss in weight. Grammes.	Corrosion factor.
1	1.24	57.0494	0.4040	100
2	1.29	57.3176	0.3276	81
3	1.45	57.6996	0.4098	101
4	1.55	54.5786	0.4028	100
5	1.72	56.9500	0.3980	99
6	2.04	59.4522	0.3846	95
7	2.28	57.6416	0.3554	88

II.—Salt Water Tests.

These experiments were carried out in a precisely similar manner to the preceding ones, save that the liquid corrosive medium was 3 per cent. salt solution (see Table III.).

TABLE III.—*Corrosion of Cast Iron in 3 per Cent.-Sodium Chloride Solution* (13 *Weeks' Exposure*).

Cast iron No.	Silicon. Per cent.	Original weight. Grammes.	Loss in weight. Grammes.	Corrosion factor.
1	1.24	57.0036	0.3134	100
2	1.29	57.3356	0.2882	92
3	1.45	57.6354	0.2974	95
4	1.55	54.9200	0.3112	99
5	1.72	57.2766	0.3182	101
6	2.04	58.5736	0.3172	101
7	2.28	58.5102	0.2758	88

III.—Alternate Wet and Dry Tests.

These experiments were carried out in a precisely similar manner to those detailed in connection with nickel and chromium steels.* The results were as in Table IV.

TABLE IV.—*Corrosion of Cast Iron exposed to Alternate Wet and Dry* (15 *Weeks' Exposure*).

Cast iron No.	Silicon. Per cent.	Original weight. Grammes.	Loss in weight. Grammes.	Corrosion factor.
1	1.24	56.0926	1.0442	100
2	1.29	56.6978	1.2116	116
3	1.45	58.2680	1.0780	103
4	1.55	55.4664	1.0424	100
5	1.72	57.2854	1.0370	99
6	2.04	58.5464	1.0738	103
7	2.28	57.5996	1.0996	105

IV.—Sulphuric Acid Tests (0.05 per cent.)

These experiments were carried out in a similar manner to those with tap water, the corroding liquid in this case being 0.05 per cent. sulphuric acid—that is, 0.5 gramme of acid in 1,000 grammes of solution with water. The acid was renewed every fourteen days. The results were as in Table V.

TABLE V.—*Corrosion of Cast Iron in* 0.05 *per cent. Sulphuric Acid* (13 *Weeks' Exposure*).

Cast iron No.	Silicon. Per cent.	Original weight. Grammes.	Loss in weight. Grammes.	Corrosion factor.
1	1.24	56.6814	0.5962	100
2	1.29	56.3498	0.6258	105
3	1.45	57.8794	0.5938	100
4	1.55	55.9416	0.5826	98
5	1.72	56.9324	0.6192	104
6	2.04	58.4756	0.6182	104
7	2.28	56.8700	0.6000	101

V.—Sulphuric Acid Tests (0.5 per cent.)

These experiments were similar to the preceding, save that stronger acid was employed, which was renewed every fourteen days (see Table VI.).

TABLE VI.—*Corrosion of Cast Iron in* 0.5 *per cent. Sulphuric Acid* (13 *Weeks' Exposure*).

Cast iron No.	Silicon. Per cent.	Original weight. Grammes.	Loss in weight. Grammes.	Corrosion factor.
1	1.24	56.9196	5.4512	100
2	1.29	56.6360	5.4486	100
3	1.45	57.9528	5.3868	99
4	1.55	55.4094	5.4218	99
5	1.72	56.7000	5.5454	102
6	2.04	58.6396	5.7658	106
7	2.28	57.6414	5.7614	106

Discussion of the Results.

For the sake of facilitating the discussion of these results, Table VII. has been drawn up, in which the corrosion factors of the cast irons as obtained in the present research are grouped together.

TABLE VII.

Cast iron No.	Silicon Per cent.	Corrosion factor in				Mean factor.	Corrosion factor in 0.5 per cent. acid.
		Tap water.	Wet & dry.	Salt water.	0.05 per cent. acid.		
1	1.24	100	100	100	100	100	100
2	1.29	81	116	92	105	98	100
3	1.45	101	103	95	100	100	99
4	1.55	100	100	99	98	100	99
5	1.72	99	99	101	104	101	102
6	2.04	95	103	101	104	101	106
7	2.28	88	105	88	101	96	106

* *Journal of the Iron and Steel Institute*, 1912, No. I., p. 249

A study of Table VII. reveals the following interesting facts:—(1) The corrosion factors for the irons in acid and neutral media are almost identical. This is very remarkable in view of the divergence usually observed between the two in the case of steels. (2) All the irons corrode at a uniform rate, although No. 7 shows a slight tendency to corrode less rapidly in neutral solution. Possibly this indicates that if the percentage of silicon were raised still higher, without affecting the proportions of graphitic and combined carbon, a gradual increase in resistance to corrosion would be observed. We may safely conclude, however, that a variation in the percentage of silicon between the limits of 1.2 and 2.3 per cent. has no appreciable influence *per se* upon the corrodibility of the cast iron. If the relative proportions of graphitic and combined carbon are simultaneously varied with the silicon, a considerable difference in the corrodibility may be expected, and this is a point upon which the authors hope to throw further light at a future date.

Multiple Moulding on the Machine in Snap Flasks.

By Ben Hird.

The production of small castings by machine moulding in snap-flasks affords a great saving in time, floor space, sand, and pouring. It is a system usually adopted for "flat backs" only; but for a number of years the writer made a large variety of small work by it, on the "Farwell Universal" and also "Pickles Turnover" machines with good success. The method on a "Farwell" is as follows:—Take, for illustration, a handle, Fig. 1. Six split patterns are made in brass with the joint line at A. The 1-in. hole is made 3/16 over full length, in the bottom half, and plugged up to the proper length after the patterns have been filed up. A hole is made in the top-half pattern large enough to fit over this thimble, so that the patterns can be pinned together and filed up in the usual way. Two plates, Fig. 2, are made to suit a 20-in. by 12-in. by 3½-in. deep snap-flask, and planed up true on one side. On one plate the six half patterns are arranged in position, and the pin holes in the patterns followed through the plate. The patterns are then removed, and the two plates put face to face and cramped, and the holes again followed through the second plate. At the same time, the holes are drilled for the flask pins. (This is one reason for using round pins, as it ensures a perfect match.) Holes are drilled in the drag plate to take the thimble forming the 1-in. hole, and also a hole in the top plate to allow the point of the runner to enter when the mould is pressed.

The snap-flasks are of the ordinary type, but fitted with special lugs *a a* to take a long, round loose pin, *b*, Fig. 3. The fitting *a a* has a top and bottom lug drilled a working fit for pin *b*, which is prevented from falling out by spring *c*, a flat piece of spring steel.

The only extra attachments to the "Farwell" machine are four lifting posts (Fig. 4); these are adjustable horizontally and vertically by means of bolts *d* and screw *e*, are fitted on the lifting table of the machine, so that the bracket *f*, Fig. 4, engages the plate at the four corners *i*, Fig. 2, when the lifting table is raised. The two front brackets *f* are made to swivel so that they can be turned out of the way, for the rolling-over operations.

When commencing to make the mould, place the drag plate on the machine, next put in position the two sticks; on these put the snap-flask, open the catch and drop the iron band, Fig. 5, inside, so that it rests on the plate (these bands can be either of cast or wrought iron; the cast are stiffer, and do not rust away as quickly, but they are more liable to get broken). Now close the snap, and push the pins

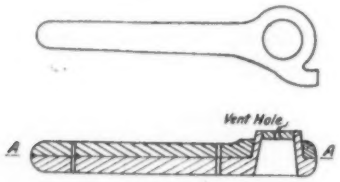


Fig. 1.

down, so that they engage the holes in the plate; sift on facing sand and fill up; strike off level and put on bottom plate; place presser board on and remove sticks, press, and turn the lot over. The best way to do the latter is to pass one arm under the mould and grip the far side; grip the front with the other hand, and the mould is easily turned over, without clamping. Now raise the lift lever until the lifting posts

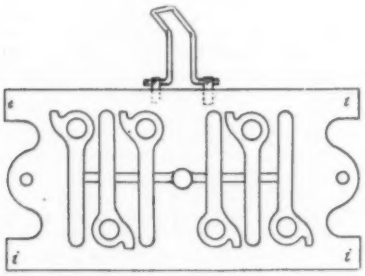


Fig. 2.

engage the four lugs (about ½ in. is sufficient clearance between the lugs and the brackets when the lever is down), vibrate the plate with a mallet and lift clear: remove the plate, lower the lifters, and place the mould and bottom plate on the floor. Again put the drag plate on the machine, this time setting in the tapered runner peg; proceed as before, but after the sand is struck off this time, sift on a layer of facing

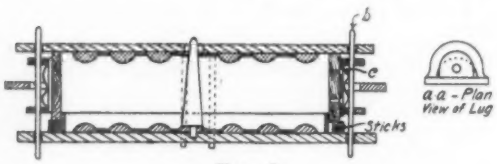


Fig. 3.

sand, then throw a little parting sand on, and place the top plate on, engaging the pins in the holes, and press as before. (On this plate the writer fixed a wrought-iron loop, hinged so that it would swing just under the bottom plate, so that the man could easily grip it; this facilitates the rolling over). After lifting and removing the drag plate, the runner peg is removed, and the flask lifted off the top plate by hand, and placed on the one on the floor, matching it with the pins; these are then removed, the lower flask unsnapped, and the operation repeated.

The moulds can be piled as high as desired or convenient for pouring. The writer has found four moulds high (three layers of castings) worked the most satisfactory. In making the top flask, the top plate

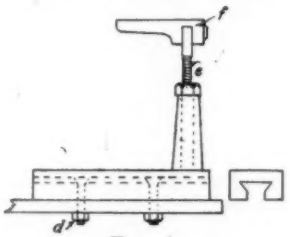


Fig. 4.

is put on the machine, and the flask put on without the sticks; the runner peg put into the hole point down, so that the wide end is about 1 in. below the top of the flask; fill well up with sand, and then place an iron band in the top of the flask, so that it stands out about an inch. Strike the sand off level with the band, put on a flat plate, and press as before; remove the plate, and scoop out to the runner peg, this forming the cup.

Fig. 5.

For securing the mould for pouring, the writer made some clamping plates and thumbscrew bolts (Fig. 6). The foot *g* is split and turned at right angles, so that it will catch under the bottom plate, and the thumbscrews are then screwed just tight on to lugs *h*. Care must be taken that the cramping plates bed well onto the top mould to prevent straining.

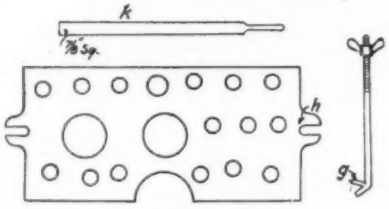


Fig. 6.

In working this principle on a press turnover machine, the operations are very similar, the only difference being that the drag plate is bolted to the turnover table. After pressing, the whole is clamped in the ordinary way, and turned over and drawn just as a mould would be, and the flask lifted off the top plate as before. The top mould is rammed by hand.

Foundry Plant and Equipment.

Portable Electrically Driven Moulding Machine.

Everyone who has had a moulding machine has at some time or other been confronted with the large amount of time and labour which is apparently wasted by the operator having to carry the moulds from the machine to the floor and walk back again. The more rapid the machine is in operation and the quicker the moulds are made, the more floor space is required to lay the moulds down and therefore the more walking has to be done. It has been computed that two men putting down 270 moulds 28 in. by 12 in. will walk six miles, which in itself is hard work when it is considered that for half that distance heavy moulds have to be carried. Other items which take a considerable amount of time are the shovelling of the sand and the shifting of the boxes back to the machine after the day's cast. Here again the fact arises that the more rapid the machine the more time and labour is required to do this work at the end of the day. In large foundries this assumes such proportions that a special staff is kept for this work.

From time to time attempts have been made to make moulding machines portable, so that they may follow the line of boxes and sand, reduce the amount of walking required by the machine operator and thus increase the rate of production. At the same time the amount of labour required to turn over the sand is considerably reduced. The difficulty of making a thoroughly satisfactory power machine which could be portable has tended to retard progress on these lines and the majority of the portable machines are of the hand-ramming type.

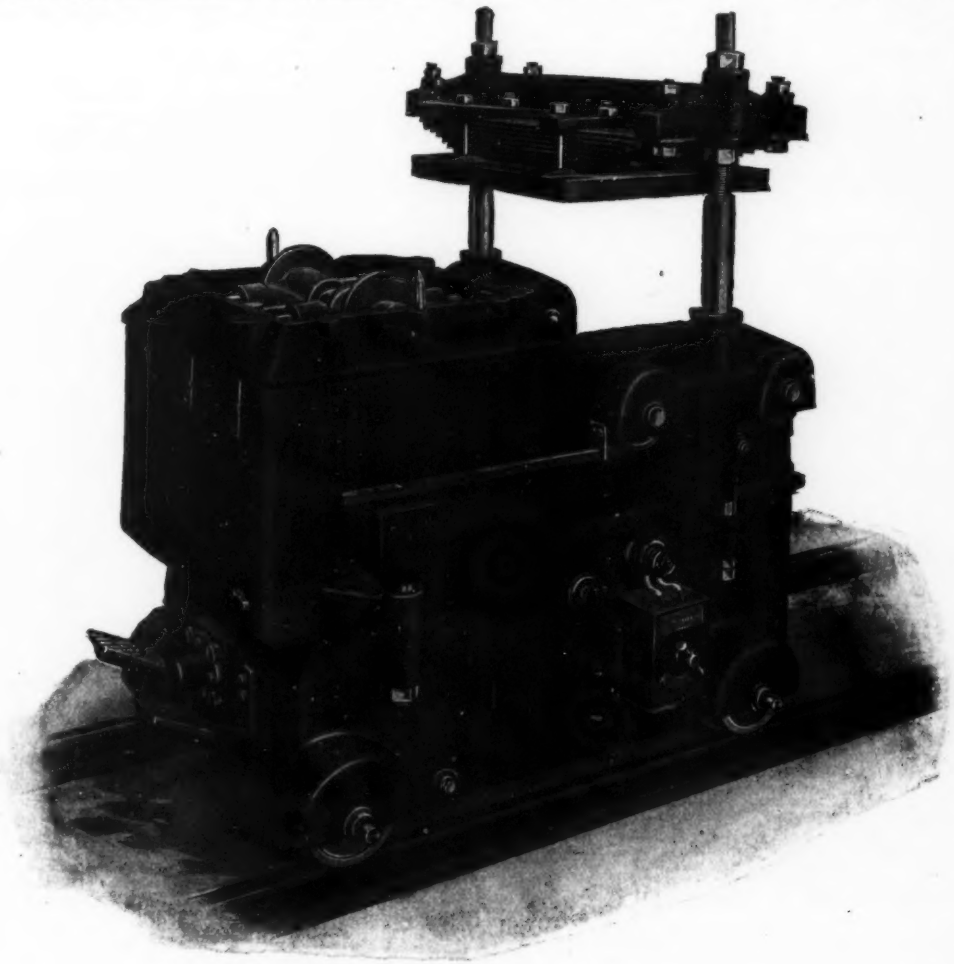


Fig. 1.—Portable Moulding Machine, Ready to Receive Box.

Recently Messrs. The London Emery Works Com-

pany, of Tottenham, London, have brought a new factor into play in utilising the electric motor for ramming the moulds, and now this method of moulding bids fair to completely overcome the difficulties above mentioned. In addition to its portability there are several ingenious devices which ensure perfect moulds being produced with ease and rapidity.

In Fig. 1 the machine is shown ready to receive the moulding box. It consists of a cast-iron box-shaped bed mounted on flanged wheels so that it can be run on rails down the foundry, following the line of boxes and sand as the work progresses. In contradistinction to the ordinary type of power-ramming moulding machine, which rams the mould from the top downwards on to the pattern, this machine rams the pattern into the sand. This method, it is claimed, produces a mould of great uniformity and of the exact hardness required on the face, and reduces venting to a minimum. The extra quantity of sand which is required to ram the mould to the requisite hardness is not placed on the top of the box as with the ordinary power machines, but the pattern-plate is sunk for this purpose below the machine table, as shown in Fig. 1. This distance can be regulated to suit different patterns and boxes. A 1-h.p. motor is all that is required to work the machine, and connected to the motor shaft is a clutch which operates the ramming and pattern drawing mechanism, and which is brought into operation by depressing one of the treadles in front of the machine. The second treadle operates four lifting rods which raise the moulding box clear of the centring pins of the machine. A hand starter and plug are fitted to the machine so that it is entirely self-contained.

Fig. 2 shows the position of the machine for ramming the mould. The operation of the machine, which is exceedingly simple, and rapid, is as follows: —After the moulding box is placed on the machine table, facing sand is riddled on to the pattern and the box filled up level with floor sand as usual. The press-head which runs on rails is brought forward and by depressing the treadle working the clutch, the mould is rammed, the pattern drawn and the clutch released. The press-head is then rolled back and the box lifted clear of the table by depressing the other treadle. The simplicity and rapidity of operation of this machine is proved by the fact that one man and a boy can put down from 25 to 30 complete boxes per hour. This machine, which practically opens up a new era in moulding-machine practice, may be seen in operation at the works of the London Emery Works Company.

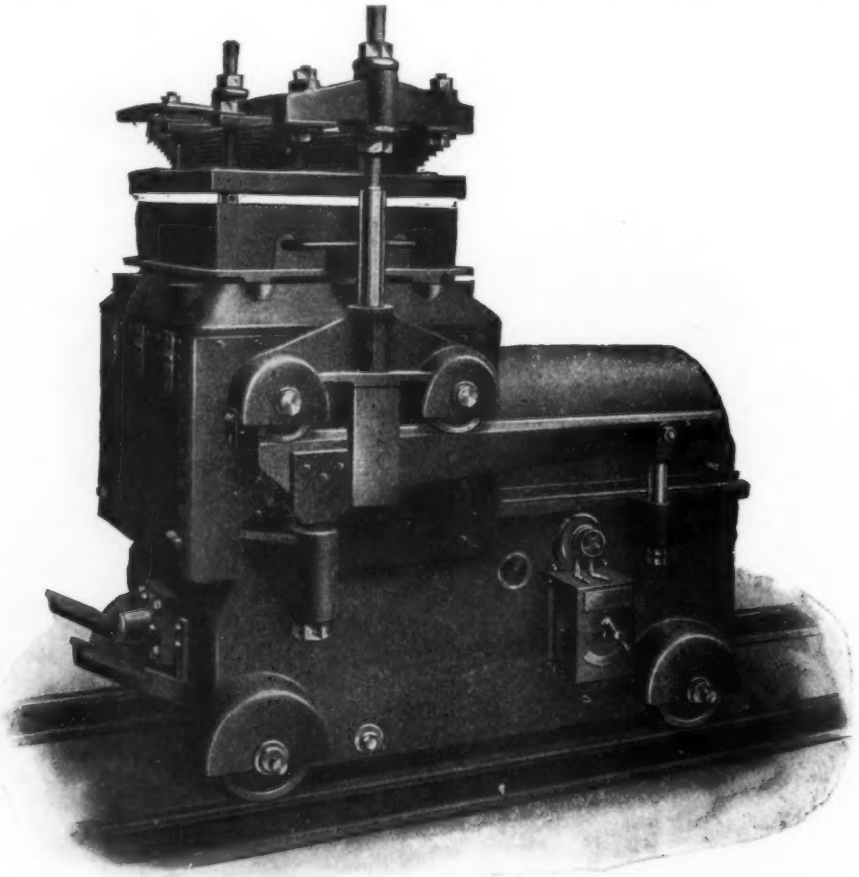


FIG. 2.—PORTABLE MOULDING MACHINE, IN POSITION FOR RAMMING.

A Metallurgical Microscope.

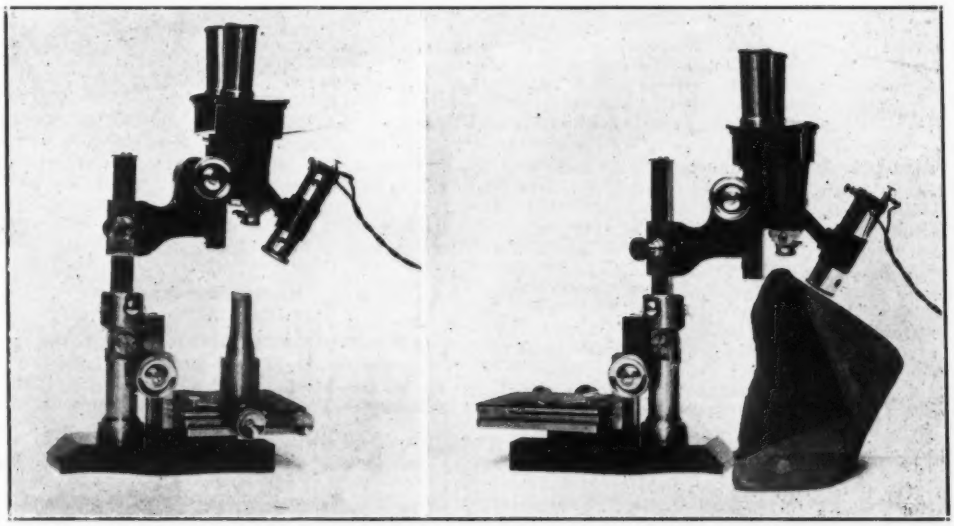
The rapid advance in the microscopy of metals has necessitated an addition to the equipment of the up-to-date metallurgical laboratory. An auxiliary microscope for the closer examination of metallic specimens other than those having carefully prepared polished or etched surfaces, has become imperative. Much greater attention has now to be given to the examination of the fractures of test bars, and also to such fractures as result from the failure of metals under every-day working conditions. Local failures due to the presence of oxide slag, dead metal, cinder or other extraneous matter, and defects due to the presence of blow holes, etc., together with the harmful effects of shrinkage and contraction, render necessary the employment of means to enable the investigator to make a most thorough examination of fractures. These defects are common to all cast metals, whether ferrous or non-ferrous. Wrought metals also may fail from like defects. The nature of the fracture, and, more particularly, the degree of crystallinity, furnish valuable information and serve as data for controlling subsequent experimental work or future manufacture.

A very well equipped and substantially built stereoscopic binocular microscope giving an erect and truly stereoscopic image and possessing many desirable features has just been completed by Leitz, the well-known optical instrumental makers, of 18, Bloomsbury Square, London. This microscope has been constructed to the specification and design of Mr. Wesley Lambert, late Chief Metallurgist of the Royal Gun Factory at Woolwich. Our illustration serves to show the chief features of this model.

The microscope proper is of the Greenough type. Two microscope tubes are so arranged as to bring the same object into focus in the axis of each tube, the tubes being set at an angle to each other for this purpose. Each tube carries both an objective and ocular. The two objectives are mounted on a single slide, the lenses being carefully paired and provision is made by a suitable adjusting arrangement to enable one to focus the object for each eye separately. Correction is thus made for any slight difference that may exist in the eyes of the observer. Provision is also made for adjusting the oculars to the correct width between the pupils of the user's eyes.

The stand comprises a heavy horse-shoe base of generous dimensions carrying a substantial pillar to which the stage and body are fitted. The latter is considerably overhung and is secured by an approved hinged joint which permits the tilting of the instrument through an angle of 90 deg. By an extremely simple slide joint, locked by a single milled head screw, the upper portion of the instrument may be detached and reversed. An examination is thereby possible of bulky specimens of too great a weight for the stage or of such size that the microscope must be mounted above or placed upon them. Independent ratchet and pinion movements are provided to the microscope and the stage. These adjustments, together with the slide and clamp to the body of the microscope, permit of the examination of specimens of considerable variation in length.

The stage is modelled upon the English pattern and is strongly constructed. It is provided with anterior, posterior, and lateral movements of considerable range. The surface plate upon the stage is removable and covers an opening. The instrument is thus available for such other purposes as will readily suggest themselves to the laboratory worker.



THE WESLEY LAMBERT METALLURGICAL MICROSCOPE; BY LEITZ.

Further details include a small fixed illuminating lamp placed in such position as will best illuminate the object. The 24, 40 and 48 mm. paired objectives with the O and III paired oculars are particularly suited for the examination of fractures, etc. at varying magnifications.

The foregoing description will suffice to show our readers that the Wesley Lambert model is possessed of just those desirable points which together with the high class workmanship for which the firm of Leitz is noted, result in the production of an instrument sure to become popular in the works' manager's office and technical laboratories.

Registering Cabinet for Patterns.

The accompanying illustrations show a patented cabinet designed by Mr. Edward Flower, 19, Cooper Street, Manchester, for registering patterns. This cabinet affords a means of readily registering and denoting or recording the whereabouts of patterns belonging to an engineering or other works, in cases where the castings are produced by, or the patterns lent to, outside foundries or works. The method is so simple that it can be worked by a youth, and is claimed to show a daily saving of work of one to two hours.

Fig. 1.—Registering Cabinet for Patterns.

The cabinet has shallow drawers or trays, each of which on being drawn out falls into an inclined position, thus accelerating the finding of the whereabouts of any desired pattern. Each drawer is ruled in columns, as shown in Fig. 2, with the units at the top running from left to right. Under each of the units is a vertical line, upon which tallies can be fixed representing and denoting the foundry or works who hold the patterns. To aid the eye, the 10's are distinguished by a bolder figure, and have a more pronounced vertical line. At each side of the drawer the hundreds are shown, each hundred being marked off by a substantial horizontal dividing line. Each drawer will record about 1,000 patterns.

The various foundries or works are denoted by differently coloured tallies, for instance, Smith's—red tally, Jones'—blue tally, Robinson's—green tally, so when it is desired to send any pattern to, say, Smith's foundry, it is only necessary to affix a red tally to the line under the said pattern number. This tally remains firmly fixed until it is removed after the pattern is returned. If Smith retains the pattern, the record remains as long as it is in his possession.

Further, by this scheme it is possible to register the same pattern as being in the hands of two or three foundries or works, in case extra patterns are made to obviate the delays caused by any particular foundry or works being full up.

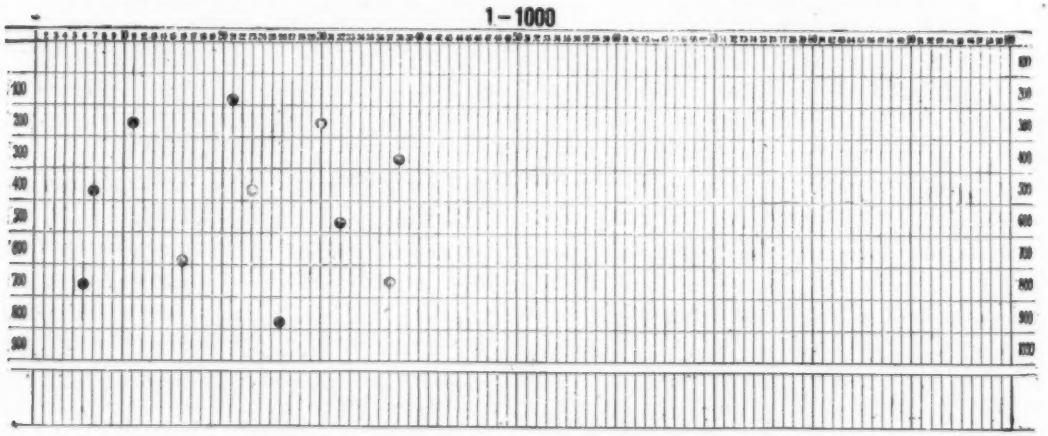


Fig. 2.—Chart of Registering Cabinet.

The Kitson-Empire System of Lighting.

In the course of our notice of the stand of the Kitson-Empire Lighting Company, Limited, at the Foundry Trades Exhibition, published in our last issue, we stated by error that "1,000 actual candle-power at the cost of 1½ per hour has been obtained by the system." The cost should be quoted as ½d. to ¾d. per hour.

Correspondence.

Blast Quantity and Pressure in Cupola Working.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The Paper entitled "Blast Quantity and Pressure in Cupola Working" by Mr. F. J. Cook, published in your last issue, has, I am sure, been read with very great interest by all those interested in cupola working, as there is no doubt that reliable information on the points dealt with in this Paper is difficult to obtain. Cupola makers themselves are not always able to specify the correct volume and pressure of air that is required to ensure the best results from their cupolas.

Recently, with the introduction of high-speed air blowers, it has been the writer's experience, in visiting the works of cupola users, to find some very sad conditions, owing to the fact that air for the cupolas was being supplied by machines of this type which were altogether unsuitable for the purpose. This condition of affairs was by no means attributable to the fan-makers' lack of knowledge as to the capabilities of the fans, but rather to their ignorance regarding the quantity and pressure of air required for a cupola of any given design and rated capacity.

The firm with which the writer is connected has been engaged for some time past in examining the performance of cupolas on very similar lines to those described by Mr. Cook; but the results obtained, in some respects, were very different. Tests were carried out under actual working conditions on several cupolas situated in different districts, using different classes of iron and coke. Variations were made in the quantity and pressure of the blast, but although the average amount of iron melted per hour as referred to the size of the cupola was distinctly higher than Mr. Cook's figures, yet in no case was the quantity of blast per ton of iron melted so low; and frankly it is hard to believe that his figures are correct.

The method of measuring the air adopted by Mr. Cook does not appear to be the best, as the large variations in the amount of change of pressure in the Venturi tube, which would result from the variation in volume, would so change the conditions of flow in this tube that even by calculations as complicated as those shown in the appendix to the Paper, an accurate result could not be expected. The method adopted in the experiments carried out by the writer's firm was that of placing a circular vessel of large capacity on the inlet of the blower, and admitting the air to this vessel through a circular sharp-edged orifice, the diameter of which was varied with the volume of air passing, so that a comparatively low, but constant, water gauge was obtained. This method has the slight disadvantage of somewhat reducing the efficiency of the blower and putting an extra load upon the motor, but the writer ventures to suggest it is otherwise more satisfactory than the Venturi tube.

Mr. Cook makes no mention of the shape of the tuyeres used in the cupolas which he tested. This is of the greatest importance; and it may be safely said that in the correct proportioning of the tuyere area to the melting zone area, combined with the correct shape of tuyere and brick lining, lies the whole secret of successful cupola design. Cupolas differing only in the design of their tuyeres and form of their brick work may be fired with the same quality and quantity of coke, charged with the same quality and quantity of iron, and supplied with the same quantity and pressure of blast, and yet the results obtained will be absolutely different from one another.

It would be very interesting to have a further expression of opinion from Mr. Cook regarding the quantities of air he has stated, and also to receive particulars of the exact shape of the tuyeres used in his experiments and the shape of the brick work lining at the commencement and the completion of his tests.

Yours, etc.,

A. LIARDET.

Bradford, July 23, 1913.

Steel in Cupola Mixtures.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—Among the many points arising out of Mr. Riddell's Paper on "Semi-Steel," and the discussion thereon, there are two of special interest. One is the curious disregard of the economy of steel additions. While it is possible with special brands of iron to obtain tensile and transverse strengths that cannot be beaten by any "faked metal," yet such mixtures are very costly, and if by aid of an admixture of steel scrap a cheaper iron can be improved sufficiently to meet requirements at a cost of even 20s. a ton less than the special mixtures, the idea is sufficiently attractive, and is a very potent incentive to experiments with steel additions, especially to those founders who sell their castings by the ton.

Another point is Mr. Riddell's statement that adding ferro-manganese to prevent oxidation increases the combined carbon and hardens the metal. Unfortunately he gives no evidence in support of this view. Increased manganese would certainly have such an effect in a simple iron-carbon-manganese alloy, but the presence of other elements, and the unavoidable changes which take place in melting in the cupola render the action of high manganese apparently contradictory. Before the American Foundrymen's Association meeting in 1908, Mr. Diller presented a chart showing the effect of increased manganese on combined carbon, with manganese rising from 0.35 to 0.65. Combined carbon went down from 1.10 to 0.05, probably by reason of the manganese neutralising the sulphur. In Mr. Coe's Paper, printed in the June number of the FOUNDRY TRADE JOURNAL, it is stated that "bar 40 was made up to contain 1.2 manganese and 0.2 sulphur," yet bar 40 was grey, stood 14.8 tons tensile, and actually contained 0.85 manganese and 0.27 sulphur. Evidently the manganese and sulphur had coupled up and gone off together, to the benefit of the metal. Mr. Carrick in his Paper on the use of chills, gives a mixture with manganese 1.75 and silicon 1.3 which he used for thin sections; and an able American foundryman has used, for castings running in parts ¼ in. thick, an iron and steel mixture with manganese up to 2.75. The non-hardenng effect of such high percentages is probably to be explained partly by the neutralising action of manganese and sulphur on each other, and also by a good deal of manganese being lost in the cupola by oxidation, thus protecting the alloy from one of the greatest dangers that the user of steel additions has to meet. There is a growing demand for castings which are at once strong, close-grained, and easily machined, and it appears possible, on available evidence, that this demand can be met with much profit to the founder by the use of a cheap medium-silicon, high-sulphur pig, steel scrap, and ferro-manganese or spiegeleisen. Owing to the high manganese, there will probably be little less carbon present than in an ordinary pig and scrap mixture, but the graphite will be in that fine state of sub-division necessary to a close-grained and strong iron, while the hardening

effect of the high sulphur will be taken care of by high manganese.

When a hard-wearing iron is needed, such as is necessary for steam cylinders, liners, rolls, etc., the problem becomes somewhat more complex. A fair percentage of sulphur must be present to give the hardness required. One cannot have a hard-wearing and easily-machined iron; the terms are contradictory. Therefore the manganese cannot be kept high or the sulphur will suffer. Similarly, the silicon must be low, or too much flake graphite will be formed. Only the greatest care and skill in melting will give success with the use of steel scrap, and prevent the oxidation of the metal with the consequent blowholes and dirt.

In the matter of research work, might I venture to suggest to those engaged in such work at our Universities, how much more valuable and understandable their work would be to the practical foundryman if their experiments were conducted with one of the numerous experimental cupolas now on the market. While the value of removing the variables from experimental work is obvious, yet the actual contact of metal, fuel, and blast which occurs in the cupola introduces conditions which can never be equalled by crucible experiments, and the effect of any variables which cannot be regulated in cupola melting, can be discounted by taking an average of a fair number of trials.

Yours, etc.,

H. SAYERS.

Hunslet.
July 8, 1913.

Queries and Replies.

Annealing of Malleable.

I have just started making malleable iron castings, with unsatisfactory results. The castings from the first annealing came out quite brittle. I used "M.H.M" pig-iron (spotted white), and melted in crucibles. The annealing material was red hematite ore, and not having any old ore, and fearing all fresh ore would be too strong for the castings, I mixed 50 per cent. of clean steel borings through the hematite in the annealing boxes. The temperature was raised to 824 deg. C. in 48 hours, and remained above this for a further 53 hours, being in the last 26 hours of this period at 900 deg. C., or slightly over, and then gradually cooled. Before annealing the castings contained 3.26 per cent. carbon. The annealing temperatures were based on the diagram shown on page 249 of the FOUNDRY TRADE JOURNAL, May, 1911, according to which the annealing temperature for 3 per cent. carbon would be 1,635 deg. F., and the proportionate advance for 3.26 per cent. would be 1,676 deg. F., or 914 deg. C. approximately. I also referred to the Paper by Mr. W. H. Hatfield in September, 1910 issue, page 492.

"W. F. M."

Answer.—The fault in your process is that the annealing temperature is too low. The iron is all right, though we have never seen really good results from the use of steel borings with ore, and would advise burning some of the new ore instead of introducing borings. The temperature mentioned is much too low, and should be raised to over 1,100 deg. C. (We have before us a sample of iron annealed at 1,200 deg. C. for only 24 hours, from entering the oven to being taken out, and it is perfectly grey.) The low temperatures you are using might serve for "blackheart" practice, but are no use for the ore process. In regard to the chart to which you refer (our issue of May, 1911, page 249), we should point out that the dotted curve in Fig. 2 showing the oven temperature outside of pot, goes up to 1,725 deg. F. (940 deg. C.)—this to heat the castings themselves to 1,575 deg. F., and with carbon 2.65 per cent. Reference to the table on page 249 of the issue in question will show that in one instance quoted up to 2,200 deg. F. (1,200 deg. C.) was attained, and this specimen gave the best results, the time of annealing being much shortened. Referring also to Mr. Hatfield's Paper (September, 1910, page 492) you will note on examination of the curve in Fig. 1, and the paragraphs "Sample A" to "Sample J," that at least 950 deg. C. appears necessary for a prolonged period to produce the annealing effect. It is quite probable that by working up to 950 deg. (for the castings, not the oven) and prolonging at that heat and slowly cooling, you may get the proper result. It must be borne in mind, however, that the curve given by Mr. Hatfield does not necessarily represent regular practice, since the test to which it refers was made for a definite experiment, and extended over 220 hours.

Applications for Patents.

An Asterisk indicates that a complete specification accompanies the application. When inventions are communicated the names of the communicators are in brackets.

13,517. Manufacture of iron. E. M. Stewart and R. Whiteside.
13,763. Ladles for casting metal. G. J. Boyle, Viscount Chetwynd.
13,778. Muffle furnaces. J. F. Le Boutillier.
14,092. Furnaces for the heat-treatment of metals. J. Lord and W. A. Russell.
14,431. Manufacturing steel. G. J. Boyle and Viscount Chetwynd.
14,432.*Furnaces. (Soc. des Perfectionnements à la Vaporisation, France).
14,478. Basic or acid steel, etc.; process for improving such metal and for converting it into a solid, hollow, or other formation; and apparatus for carrying out such process. H. Reinhard.
14,541. Reversible regenerative gas furnace of the Siemens type. A. Reynolds.
14,581. Oil-furnaces for heating and melting metals. P. W. Allday.
14,726.*Crucible furnaces. V. Coppée.
15,099.*Ingot moulds. H. Jouanneau.
15,101.*Foundry-moulding boxes. H. Rudman, H. T. Lancey, and J. E. H. Craven.
15,102.*Hand-operated moulding-machines. H. Rudman, H. T. Lancey, and J. E. H. Craven.
15,542. Moulding and casting metals. Alchemy Gold, Limited, and G. Sallis.
15,924.*Treating steel and compositions of steel. J. Churchward.
16,307.*Metallurgical furnaces and the metallurgy of copper. L. Addicks and C. L. Brower.
16,520. Moulds for casting regular surfaces such as helices of propellers. A. K. Huntington and F. G. P. Preston.
16,530. Apparatus employed in casting metals. L. Ferman.

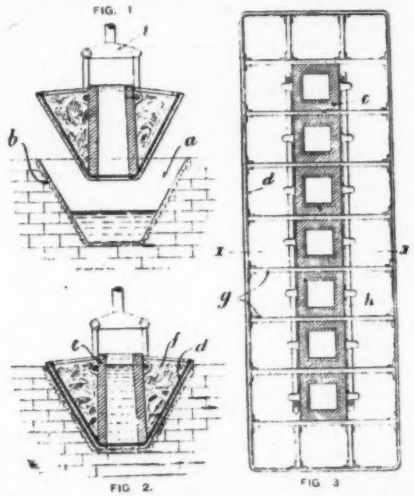
A presentation has been made at the Cyclops Works of Cammell, Laird & Company, Limited, Sheffield, to Mr. A. O. Hutchinson, who is retiring, after 15 years' service with the firm. Mr. Hutchinson, during the whole of this time, has had charge of the railway rates department.

MR. D. EVANS, who has been transferred from the managership of the Tytrist Colliery, Tredegar, to that of the Oakdale Colliery, in the Sirhowy Valley, belonging to the Tredegar Company, has been the recipient of a testimonial by the officials and employes of the company and by his friends at Tredegar.

Inventions.

Abstracts of British Patent Specifications recently accepted.

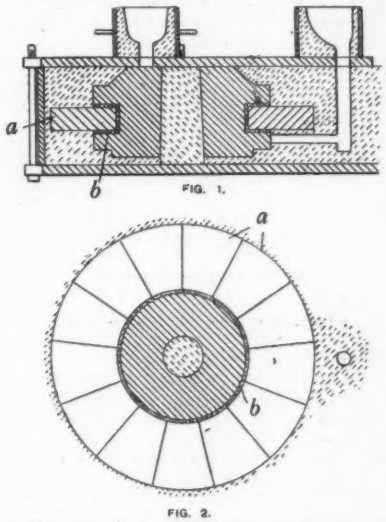
6,027 (1913). *Process of Casting Ingots of Metal and Alloys and Apparatus therefor.* P. H. G. Durville, 43, rue de Berlin, Paris.—Fig. 1 is a cross section on line *x*—*x* of Fig. 3, showing the solidification frame suspended above the reservoir. Fig 2 is a similar view, showing the mould lowered into the reservoir; and Fig. 3 is a plan of a frame furnished with a series of moulds. The apparatus comprises an intermediate reservoir *a* formed in a bed *b* of suitable refractory material, which may form part of the floor of the workshop, or be movable and transportable; the shape of the reservoir being made to suit the dimensions of the ingots desired, the internal walls of the reservoir being tapered outwardly as shown, towards the top, the hollow thus formed being intended to form an exact lodgment for the apparatus which effects the solidification and which is now to be described. For effecting the solidification



Apparatus for Casting Ingots of Metals and Alloys.

of the ingots use is made of a solidification frame, which comprises a centrally-arranged mould *c* with its inner walls tapering inward towards the top, the upper and lower faces being fully open, the mould is surrounded by a casing *d* having the same configuration as the reservoir *a*, the external walls of the casing may, as shown, be lined with refractory material *e* of low heat conductivity, the intervening triangular space being filled in with sand, pieces of pig-iron, etc., *f* to give the necessary weight to enable the frame to sink into and displace the molten metal. According to Figure 3, a number of moulds *c* are arranged longitudinally in a casing *d*, the walls of the casing being held together by transverse bars *g*. The moulds *c* are drawn together and supported in the frame by longitudinal bars *h* to which the means *i* for lifting the solidification frame as a whole may be attached. The thickness of the side walls of the mould is determined by that ratio—between their mass and that of the molten metal—which is most appropriate for effecting the solidification in the most favourable conditions of slowness or rapidity. The inner surfaces of the walls of the mould are, of course, properly smoothed so as to produce a fine surface on the corresponding face of the ingots. If necessary the solidification frame and the intermediate reservoir may be heated so that any very sudden solidification of the molten metal when the frame is brought into contact therewith may be avoided.

17,227 (1912). *Casting of Iron.* I. E. Lester, 44, Sandwell Road, Handsworth, Birmingham.—Figure 1 is a diagrammatic sectional side elevation, and Figure 2 a sectional plan, of a mould adapted for the production of a roll in accordance with this invention. The mould is produced in the ordinary way, but embedded therein adjacent to the parts at which a hard wearing surface is required in the casting are a number of metal segments *a*, which are grouped or arranged together in any convenient manner. The segments are shaped to correspond with the configuration of the portion of the casting to be chilled or hardened, and such portions are covered with a relatively thin coating *b* of sand of uniform thickness. Thus there is obtained a complete matrix of sand with an embedded metal portion which when the molten metal is poured into the mould produces cooling of the casting adjacent to the embedded metal at the rate necessary to give the desired qualities of hardness and toughness. By varying the thickness of the sand covering the metal portion the relative amounts of hardness and toughness can be varied to meet any particular requirement. Further, the sizes of the metal portions may also be varied for a like purpose. The inner ends of the metal or cooling segments are



Lester's Improved Method of Casting Iron.

varied in shape to suit the particular section of the roll to be cast.

25,858 (1912). *Making of High-grade Pig-iron.* P. L. T. Heroult, 149, Broadway, New York, U.S.A.—A specific example of the process is as follows:—In the blast furnace ore is melted with coke in the usual way for making ordinary foundry iron. The product contains approximately the following:—Carbon, 3.50 to 4.00 per cent.; silicon, 0.20 to 3.00 per cent.; manganese, 0.20 to 2.00 per cent.; phosphorus, 0.10 to 1.50 per cent.; sulphur, 0.15 to 0.20 per cent. This product is carried into molten condition to the electric furnace with a basic lining, and basic slag introduced. The current is then applied and regulated so as to make the slag quite fluid, and the process is continued until, by the appearance of the slag and by other tests, it is clear that the bath has been reduced in sulphur content to from 0.01 to 0.04 per cent. of sulphur. The iron thus refined is then tapped. The contents of carbon, silicon, manganese and phosphorus in the final product can be varied at will by choosing the ore and making the ordinary pig-iron accordingly. Or dephosphorisation may be carried on in the electric furnace, if desired. The carbon, for example, can be increased by the addition, in the electric furnace, or in the ladle of carburite or other known means, or can be decreased by the addition of soft scrap. Silicon and manganese can be added at will by the addition of ferro-silicon or ferro-manganese, or can be decreased by the addition of oxide of iron in the slag.

Trade Talk.

THOMAS HARRISON, LIMITED, engineers, have removed to 103, City Road, Bradford

THE ALEXANDER MANUFACTURING COMPANY have removed to 85, Great Eastern Street, London, E.C.

GEO. BAYLIFF & SON, LIMITED, Wirral Foundry, Beaufort Road, Birkenhead, are retiring from business.

ACCLES & POLLOCK, LIMITED, have removed from Churchbridge, to Rounds Green, both Oldbury, Birmingham.

THE London offices of John Fowler & Company (Leeds), Limited, have been removed to 113, Cannon Street, E.C.

BABCOCK & WILCOX, LIMITED, have removed their Cardiff office to more commodious premises at 102, St. Mary Street, Cardiff.

A FIRE has occurred at the Albion Works, Saville Street, Sheffield, of T. W. Ward, Limited, but only slight damage was done.

MESSRS. KENWORTHY, TAYLOR & COMPANY, of the Barnsley Foundry, Wellington Street, Barnsley, are giving up business.

THE BATES ENGINEERING COMPANY, LIMITED, is being wound up voluntarily, with Mr. H. Sadler, 31, North John Street, Liverpool, as liquidator

MESSRS. J. L. RILEY and C. A. RILEY, trading together as the Richmond Iron and Steel Company, Stockton-on-Tees, have been adjudicated bankrupts.

A FIRE occurred in the moulding shed of the Rosebank Iron Works, Edinburgh, occupied by Brown Brothers & Company, Limited, but the damage was not heavy.

MONKS, HALL & COMPANY, LIMITED, of Warrington, have established a branch at 8-10, Hotham Street, London Road, Liverpool, with Mr. W. O. Milner in charge.

MR. H. P. CARTER, secretary of the Manufacturers' Agents' Association, informs us that the offices have been removed to 90 & 91, Queen Street, Cheapside, London, E.C.

THE address of the Sheffield branch of the British Thomson-Houston Company, Limited, of Rugby, will, after August, be 8, East Parade, instead of 41, Church Street.

MESSRS. MARKHAM & PRANCE, of Dudley House, Southampton Street, Strand, London, W.C., have established a branch at Newcastle Chambers, 72, High Street, Southampton.

THE RAILWAY AND CANAL COMMISSION have granted permission to the South-Eastern and Chatham Railway Companies' Managing Committee to raise their rates for certain traffic.

HENRY HOPE & SONS, LIMITED, propose establishing a branch factory at Peterborough, in Canada, where very favourable terms have been granted to the company by the municipality.

THE manufacture of non-ferrous fittings and accessories for general engineering purposes has been taken up by W. H. Wood & Lamplugh, Limited. King's Road, Tyseley, Birmingham.

THE CITY PREMISES (BUILDING) FUND OF THE INSTITUTE OF MARINE ENGINEERS has now reached £6,000, but the sum required is £12,000. A site on Tower Hill has been secured, and tenders have now been accepted for the construction of the site.

MORRIS & LISTER (LONDON), LIMITED, 3 and 4, Palace Chambers, Bridge Street, Westminster, London, S.W., have been appointed sole selling agents for Morris and Lister, Limited, of Coventry.

THE creditors of Lupton Constantine, Springfield Ironworks, Hipperholme, Yorkshire, are required to send particulars of their claims to Mr. J. N. Lister, 21A, Silver Street, Halifax, by August 9.

A DISASTROUS fire occurred at the works of the Star Engineering Company, Limited, Wolverhampton, practically destroying three shops. The adjoining premises of Messrs. Dobbs, brassfounders, were saved.

WITH a view to bringing iron and steel manufacturers into direct contact with the scientific work that is being done at Sheffield University, a university metallurgical club has been started by Professor J. O. Arnold.

CORNELIUS WHITEHOUSE & SONS, LIMITED, of the Cannock Edge Tool Works, Bridgtown, Cannock, South Staffordshire, have appointed Mr. J. McDougall, of Glasgow, as their North of England and Scottish agent.

NALDER BROTHERS AND THOMPSON, LIMITED, are removing their head offices and factory from 34, Queen Street, London, E.C., to 97A, Dalston Lane, N.E. The Queen Street premises, however, will be retained as branch offices.

THE partnership heretofore subsisting between Messrs. A. Fildes, S. C. Fildes, and A. C. Fildes, carrying on business as engineers' small tool manufacturers, at Greenodd, near Ulverston, under the style of Sansom and Company, has been dissolved.

THE ISCA FOUNDRY AND ENGINEERING COMPANY have converted their business into a limited company, bearing the name of the Isca Foundry Company, Limited. Mr. A. H. Laybourne has been elected to the office of managing director, and the other director is Mr. R. C. T. Laybourne.

THE Sheffield steelmakers are endeavouring to get the British patent for the new cobalt steel made at the Becker Steelworks, Willich, Germany, revoked on the grounds that the invention is not novel in this country, and that high-speed steel containing cobalt has already been made in Sheffield.

THEIR Lordships of the First Division of the Court of Session at Edinburgh have granted the petition of Alexander Turnbull & Company, Limited, engineers, St. Mungo Works, Bishopbriggs, Glasgow, to confirm the reduction of the capital to £31,350, divided into 20,000 preference shares of £1 each and 30,000 ordinary shares of 7s. 6d.

THE partnership heretofore subsisting between Messrs. H. S. Sutton and C. E. Sutton, carrying on business as metallurgists, at Neath, under the style of Thos. S. Sutton & Sons, has been dissolved so far as concerns Mr. C. E. Sutton, who retires from the firm. Mr. H. S. Sutton will continue to carry on the business under the style of Thos. S. Sutton & Sons.

THEIR Lordships of the First Division of the Court of Session at Edinburgh have ordered intimation of a petition presented at the instance of Dron & Lawson, Limited, engineers and machine makers, Cranstonhill Tool Works, Glasgow, praying their Lordships to confirm the reduction of the capital from £20,000 to £15,000, divided into 10,000 6 per cent. cumulative preference shares of £1 each and 10,000 ordinary shares of 10s. each.

THE annual meeting of the members of the Association of Consulting Engineers has been held, Mr. G. Midgley Taylor presiding. It was announced that the retiring members of the Council—Messrs. W. T. Douglass, B. Latham, E. L. Mansergh, E. H. Stevenson, J. H. Harrison, and T. L. Miller—would be succeeded by Professor D. Capper and Messrs. E. M. Eaton, R. Hammond, A. J. Martin, H. S. Childe, and W. L. Spence. It was decided that membership of the Institution of Civil Engineers of Ireland should be deemed sufficient qualification for membership of the Association.

AN adjourned meeting of the creditors of Alfred Enoch Jones, 39, St. Peter's Road, Handsworth, ironfounder, has been held at the offices of the Official Receiver, Corporation Street, Birmingham. Mr. A. S. Cully (Official Receiver) explained that the meeting was adjourned in order to give the debtor an opportunity to lodge sufficient money with him to pay the creditors in full and the statutory interest. He was glad to say that such arrangements had now been made. Proofs had been lodged in eighteen claims amounting to £740 5s. 8d. Under the circumstances it was not necessary to pass any resolution.

AT a meeting of the coal trade of Hull on Wednesday night it was decided to form a football club for the

trade, to be known as the Hull Exporters' Football Club. The officers elected were :—President, Mr. E. O. Ohlson; captain, D. R. Murie; vice-captain, Captain J. Darling; joint secretaries, Messrs. H. D. Rix and E. B. Rix; and treasurer, Mr. G. Chapman; committee, Holden, Mungall, A. Lutze, G. Westmorland, Lumley, Pace, Dodd, Cowell, Branfoot, and Richardson. The colours of the club will be coal black, and the ground is the Young People's Recreation Ground. Friendly matches will be played the first year.

THE OSIER BED IRONWORKS, Horseley Fields, Wolverhampton, were offered for sale on July 22, on instructions from the receiver for the debenture holders, Mr. A. E. Mason. The works have been lately carried on by Z. W. Onions, Limited. Although there was a fair attendance no bid was offered for lot 1, which consisted of the whole concern. Lot 2, consisting of the household site, the fixed plant, and the erections thereon, was started at £1,000. The bidding went up to £2,700, but as it stopped there the lot was withdrawn. The loose stock and effects were then sold.

AT Wednesbury, on July 22, the Mayor laid the foundation stone of a new metallurgical and engineering institute, which is being erected by the Staffordshire County Council, in conjunction with Wednesbury Town Council and other local authorities. The building will consist of two storeys and a basement. The accommodation on the ground floor will include a large engineering laboratory, a laboratory for applied mechanics, and another for electrical and other tests. Upon the first floor there will be a metallurgical laboratory, with furnace and pyrometer rooms, metallography and chemical laboratories, in addition to a lecture room and class rooms.

INTERESTING experiments have been conducted in Messrs. Stewarts & Lloyds' warehouse, Glasgow, with the Ostermann apparatus for the metalising of materials of all kinds. During the experiments it was shown that the plant was capable of coating a variety of articles in metal, wood, glass, paper and stone. The coating is forced at high pressure from the nozzle of a sprayer in a thoroughly atomised state. It is claimed for the process that it can be used for an exceedingly wide variety of purposes, from the coating of ships' bottoms or other large steel structures to the metalising of looking-glasses, or even of fine woven material such as that which is used in the making of aeroplanes and airships.

OF direct processes there are no end. It may be remembered that some time ago Mr. Thomas Rouse was working on the possibility of converting into practical use the deposits of iron sands which exist in large quantities in New Zealand, Canada, and many other parts of the world, and made a quantity of pig-iron in the small cupola furnace at his works. Since then he has made several improvements in his process, by means of which it is claimed that these iron sands and fine ores can be concentrated, and smelted in a gas-fired furnace into iron and steel in one operation. We understand that a company is about to be formed, with offices at 38, Salisbury House, E.C., to work the process, and that demonstrations on a commercial scale will shortly be given.

A DEPUTATION, consisting of Sir John Randles, M.P., Mr. Needham, M.P., and Mr. Nuttall, M.P., has waited on the President of the Board of Trade on behalf of the Manchester Chamber of Commerce with a request for early legislation amending the Patent Laws. The deputation in particular asked for the remedying of the defect revealed by a recent legal decision that when the adequate working of a patent is in question the onus of proof lies on the plaintiff and not on the patentee. Mr. Buxton, in his reply, admitted, it is understood, that an amendment of the law was required. He pointed out, however, that the matter was a more complicated one than appeared at first sight, and that the particular amendment desired would have to be accompanied by other changes. In view of the opposition a Bill was likely to excite, he saw no possibility of passing it in the present session.

A NUMBER of Birmingham manufacturers have provided a guarantee fund, and have given the impetus to a movement for writing the history of the brass and copper trades in this country. An editorial committee has been appointed, of which Mr. G. W. Mullins, of the King's Norton Metal Company, Birmingham, is chairman, and Mr. P. M. Ellis, of Messrs. C. Ellis and Sons, King's Norton, and Mr. J. S. Harrison, late of the Birmingham Metal and Munitions Company, Limited, are the other members. Mr. R. K. Dent, of "Wyaston," Wylde Green, Birmingham, a gentleman already very well known for his historical work and for his knowledge of Old Birmingham, and who, until recently, was head of one of the large libraries there, has been appointed editor. The committee are proposing to collate all existing historical sketches of the trade, and are making a very large search into various historical records, etc., that have not been examined previously for this purpose, for additions. The committee are also appealing to all manufacturers and to the technical side of universities and schools, and to all individuals interested in the trade for additional data. Information regarding the scheme will be supplied by Mr. Dent.

THE FRODAR IRON AND STEEL COMPANY, LIMITED, have made an issue at par of 60,000 6 per cent. cumulative preference shares of £1 each. The company, whose share capital is £150,000 specialises in high-grade pig-iron and steel, and has recently extended its operations to include the manufacture and sale of "Chamotte" (fire-resisting and acid-proof) materials. The "Chamotte" business is conducted through the medium of a separate company, over 99 per cent. of whose capital is owned by the Frodair Company. The customers for the company's irons and steels and for the "Chamotte" products being largely identical, the company is able to work both businesses through the same selling organisation with advantage and economy The company, says the prospectus, regularly supplies its goods to many of the chief Government departments, railway companies, shipbuilding yards, engineering works, and foundries throughout the world. On the advice of Dr. P. G. Strassmann (a director of the company and general manager of the Chamotte Works) the Board recently decided to spend some £15,000 in extending the works and machinery, and to provide about £10,000 additional working capital, partly to deal with the increased output occasioned by this extension. The extensions to the works will be completed this month, and the proceeds of the present issue will be utilised to pay for the same, and to repay advances made in connection therewith and to provide additional working capital.

A VERY important meeting of the ironmasters of Cleveland has been held at Middlesbrough to consider a suggestion put forward by Messrs. Bolckow, Vaughan & Company, Limited, for the formation of a company for the distribution of Cleveland pig-iron. This suggestion has arisen out of the situation created by the failure of Messrs. Jas. Watson & Company, who were one of the largest distributing firms in the iron trade of the kingdom. The formation of such a distributing company, as proposed, would, it is understood, render the continued existence of the Public Warrant Store superfluous. The meeting adjourned, it being understood that the subject should be considered by all the firms concerned, and another meeting subsequently called. The new proposal was the sole topic of conversation in iron trade circles of late. No details are as yet to hand, but the scheme appears to be to form a limited company, the shares of which are to be held by the various firms concerned. To this company the whole of the iron produced will be sold, and the company in its turn will sell to merchants and consumers, the net proceeds being divided *pro rata* among the makers. There is, it is stated, an almost exactly similar syndicate in being among the salt producers of Tees-side. The affairs of the new company will, it is understood, be controlled by a Committee of Management, representing the shareholders, and the price of pig-iron will be fixed from time to time by this Committee. Nothing is known as to the capital of the company, but if it is to operate with the same freedom and promptness as the merchants, it must necessarily be large.

Legal.

Spencer & Cook v. Lancashire & Yorkshire Railway.

In the Manchester County Court, Judge Mellor, K.C., has delivered a deferred judgment in an action in which Spencer & Cook, Limited, engineers and ironfounders, of the Empire Works, Stalybridge, claimed damages for breach of contract on the part of the Lancashire and Yorkshire Railway Company in not delivering to the Eagle Spinning Company, Rochdale, within a reasonable time five stripping rollers. The defendant company had paid into court one guinea and two shillings costs in satisfaction of the claim.

The Judge said that the rollers were intended for use in a spinning mill, and were delivered by the plaintiffs to the defendants on May 30 of last year for carriage from Stalybridge to the works of the Eagle Company at Rochdale, a distance of about fifteen miles. According to the evidence they arrived at Rochdale the next morning, but were not delivered. After four or five days the plaintiffs began to make inquiries as to their whereabouts. Twelve days after the despatch they told the railway company that if the rollers were not delivered next day they would have to make new ones. On June 12, having received no communication from the railway company, they telephoned to the effect that unless the rollers were delivered within half an hour they should proceed to supply fresh ones, and as that was not done, they did so. About six hours later the railway company delivered the original ones. The railway company admitted that it was unreasonable for them to have taken twelve days to deliver goods over a distance of fifteen miles, and so the question arose as to what damages the plaintiffs could recover. The principle in such cases was clear, but a difficulty arose because the railway company had not had notice that this was a special contract for the delivery of a special kind of roller, and they therefore submitted that their liability was practically nothing. The value of the rollers was £12 10s. He found as a fact that the plaintiffs acted reasonably in supplying fresh rollers after having waited twelve days, and held that they were entitled to the value of the rollers after deducting something for profit and something for the value of the original rollers now in their possession. He awarded them £8, and as the case was one of considerable importance to a large class he allowed costs on the B scale.

Leave to appeal was applied for by the company and granted.

Samuel Brierley and Son v. the North Staffordshire Railway Company.

The claim of the plaintiffs, who are scrap-iron dealers at Blackburn, was as follows:—In October, 1912, the plaintiffs forwarded a load of scrap-iron in a truck belonging to the London and North-Western Railway Company to be conveyed and delivered by the defendants to the Shelton Company at Etruria. The Shelton Company refused delivery of the scrap-iron, and notice of such refusal was received by the plaintiffs from the defendants on October 24, 1912. The plaintiffs by a letter of the same date instructed the defendants to deliver the scrap-iron to a customer in St. Helens. The defendants, it was said, neglected to comply with such instructions and wrongfully detained the scrap-iron, and refused to deliver possession thereof to the plaintiffs or to their customer in St. Helens unless and until a claim for demurrage was paid. On December 5 the plaintiffs, for the purpose of obtaining delivery of the scrap-iron, paid under protest the sum of £1 17s. 10d. for unloading, reloading, and demurrage. It was claimed that, through the action of the defendants, the plaintiff had lost profit on the sale of the scrap-iron, and had been put to loss and expense. In addition to the amount paid under protest, the plaintiffs claimed £12 13s. as damages for loss of profit, etc., being a total of £14 12s. 10d. A member of the plaintiff firm said the company claimed demurrage for 11 days at the rate of 3s. per day. This charge, he contended, was excessive, his firm never having paid more than 1s. 6d. a day before. Instructions were given to the London and North-Western Company to send on the goods from Warrington and charge to the ledger account. Subsequently, however, the North Staffordshire Company were asked to collect the freight from the Shelton Company. Mr. Maxwell, for the defendants, argued that where the consignee failed to accept the goods, the carrier, whose duty it was to collect the charges was entitled to exercise a lien upon them. His Honour, in giving judgment for the plaintiff firm, held that there was a contract between Brierley's and the London and North-Western Company for the freight to be debited to the ledger account. Hearing nothing about the goods for 11 days, the plaintiffs had reason to believe that the transaction had gone through properly, and he therefore thought the charge for demurrage was unreasonable.

Deaths.

Mr. A. Ross, of Messrs. Ross, Hotchkiss & Company, engineers, Old Kent Road, London, S.E., died recently at the age of 68 years.

Mr. W. H. Murton, of Messrs. Murton & Varley, engineers and ironfounders, of Tun Street, Keighley, died recently, aged 66 years.

Mr. J. C. Jackson, of Messrs. Jackson & Ogden, engineers, of the Lansdowne Works, Middleton Road, Oldham, died recently at the age of 63 years.

Mr. T. H. Thacker, manager of the business of William Gilpin, Senr., & Company, Limited, edge-tool makers, Cannock, has died suddenly, aged 69 years.

The death is announced from Vienna, at the age of 83 years, of Herr Rath. Viktor Wolff, the secretary of the Austrian Verein der Montan, Eisen und Maschinenindustrielle.

The death took place recently of Mr. J. Ashmore, steel works manager to Messrs. Moss & Gamble Bros., which position he had held for seventeen years. The deceased gentleman was 68 years of age.

Mr. J. A. Drake, managing director of Drakes, Limited, gas engineers, Ovenden, Halifax, and a Halifax borough magistrate, died at his residence, Heath Lodge, Halifax, on July 4, at the age of 62 years.

The death is announced of Mr. Cuthbert Meadows, of Holly Mount, Clarkegrove Road, Sheffield, the chairman and managing director of C. Meadows & Company, Limited, Alliance Forge and Rolling Mills, Sheffield.

The death is reported from Brussels of Professor Eug. Gillon, Professor of Metallurgy at the University of Liege. The deceased, who was born in 1826, was one of the founders, in 1857, of the "Revue Universelle des Mines et de la Metallurgie."

The death occurred at Retford, recently, of Mr. Allen Ransome, head of the well-known engineering firm of A. Ransome & Company, Limited, Newark. The deceased, who was 80 years of age, was the second son of the late Mr. A. Ransome, of Ipswich. In 1855 deceased was manager to the firm in Chelsea, which became the present concern when it was removed in 1900 to new works at Newark.

The death has occurred of Mr. G. H. Daglish, of Liverpool, in his seventy-fifth year. The deceased gentleman was apprenticed to Messrs. John Hick & Company, Soho Ironworks, Bolton, and after six years with that firm he entered the business of Robert Daglish & Company, St. Helens Foundry, St. Helens, Lancs., subsequently becoming managing partner. The business has since been converted into a limited liability concern.

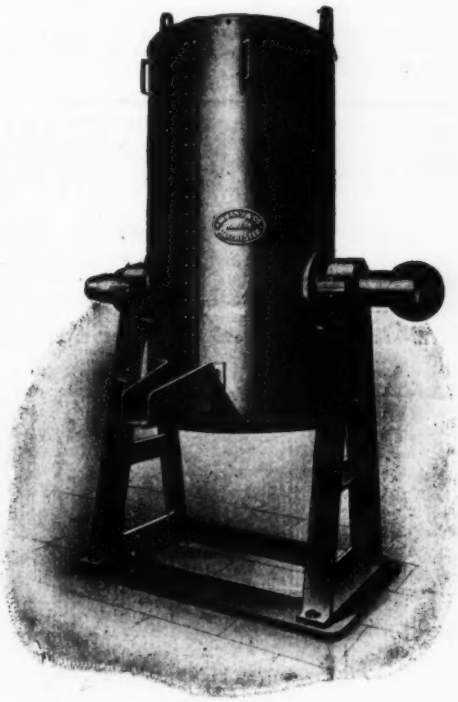
The death has taken place at Rosside, near Ulverston, in North Lancashire, of Mr. John Stones, at the age of 80 years. Mr. Stones was the inventor of a system of revolving shutters, and commenced to work his patents in Ulverston in 1868. He carried on business at the Ure Mill, until 1872, when that building was burnt down, and he took over the Dragley Beck Foundry, the business being turned into a limited liability company.

AS SUPPLIED TO THE ADMIRALTY, WAR OFFICE,
COLONIES, AND FOREIGN GOVERNMENTS.

THE Cupola.
Evans's Rapid.

Foundries Completely Furnished.

EVANS'S NEW CUPOLETTE
For Emergency Work.



James Evans & Co.,
Britannia Works,
Blackfriars,
MANCHESTER.

Telegrams: "LADLES, MANCHESTER."

New Companies.

K. C. B. Foundry Company, Limited.—Capital £3,500 in £1 shares.

Willys Overland, Limited.—Capital, £10,000 in £1 shares, to carry on the business of engineers, etc.

J. Oswald & Sons, Limited.—Capital £8,000 in £1 shares, to carry on the business of ironfounders.

John Fowler & Company (Manila), Limited.—Capital £5,000 in £10 shares, to carry on the business of engineers.

Lester Engineering Company, Limited.—Capital £5,000 in £1 shares. Registered office: 18, Albion House, 59—61, New Oxford Street, W.

Charles Harrold & Company, Limited.—Capital £60,000 in £1 shares (30,000 preference), to carry on the business of refiners of metal.

James Adams & Son, Limited.—Capital £2,000 in £1 shares, to carry on the business of ironfounders. Registered office: 105, Union Street, S.E.

Barns Brass Foundry, Limited.—Capital £4,000 in £1 shares (2,000 preference). Registered office: The Foundry, Hill Street, Pocock Street, Blackfriars Road, S.E.

Autokal Syndicate, Limited.—Capital £50,000 in £1 shares (20,000 preference), to carry on the business of engineers. Registered office: 152½, Blackfriars Road, Southwark, S.E.

R. C. Walker & Company, Limited.—Capital £1,000 in £1 shares to carry on the business of ironfounders, mechanical and marine engineers, etc. Registered office: Havenside, Grimsby.

Green & Carter, Limited.—Capital £2,500 in £1 shares, to carry on the business of ironfounders, etc. Registered office: Vulcan Iron Works, Kingsworthy, near Winchester, Hants.

F. & P. English, Limited.—Capital £500 in £1 shares (250 7 per cent. cumulative preference), to carry on the business of mechanical engineers, etc. Registered office: 8, Victoria Street, Redditch.

Burners, Limited.—Capital £2,000 in £1 shares, to carry on the business of manufacturers of gas burners and fittings, brassfounders, brass cutters, etc. Registered office: 42, Ingleby Street, Birmingham.

Aldbell Company, Limited.—Capital £5,500 in 5,000 preference shares of £1 each and 10,000 ordinary shares of 1s. each, to carry on the business of engineers. Registered office: 78, Coleman Street, E.C.

Marshall Arter, Limited.—Capital £7,000 in £1 shares (1,000 preference, 4,000 ordinary, and 2,000 Founders,) to carry on the business of engineers. Registered office: Beavor Lane, Hammersmith.

James Menzies & Company, Limited.—Capital £5,000 in 2,000 preference and 3,000 ordinary shares of £1 each, to acquire and carry on the business of engineers, millwrights and smiths. Registered office: 52, Mount Street, Glasgow.

Gaskell & Chambers (South Wales), Limited.—Capital £5,000 in £1 shares, to take over the business of bar and general engineers, and fitters, coppersmiths, etc., carried on at Bute Street, Cardiff, and elsewhere, as Brownlow & Company.

Bruce & Hyslop, Limited.—Capital £4,500, in £1 shares (1,500 preference), to take over the business of steel, iron and brassfounders, etc., carried on by A. Bruce and A. M. Hyslop, at Well Lane, Bootle, Lancashire, as Bruce & Hyslop.

Hargreaves (Birmingham), Limited.—Capital £1,000 in £1 shares, to take over the business of a hardening specialist and engineers' merchant, carried on by S. Hargreaves at 33, Essex Street, Birmingham, and the similar business carried on by F. J. Kind at 71, St. John's road, Selly Park, Birmingham. Registered office: 137a, Suffolk Street, Birmingham.

A NEW STEEL BARROW

(PATENTED)

"BRABY'S BALANCED BARROW."

The Handiest and Cheapest Barrow in the market. Specially designed for coal, dross, ashes, etc. Its capacity is **25 per cent. greater** than the ordinary style, yet it can be wheeled with **half the labour**, and can be emptied **much more quickly**. It is a **perfectly balanced** barrow, and a full load can be **easily wheeled by a boy.**

NOTE.—This Barrow can be taken right up to mouth of furnace and the ashes drawn into the barrow direct from the furnace.

The "B.B.B."

BRABY for high grade **STEEL**
SHEETS & PLATES up to 15 FEET LONG.
RANGE of GAUGES 8 to 30 W.G.
RANGE of WIDTHS 12 to 60 in.

BRABY for improved wrought **STEEL**
BARROWS, BOGIES, TRUCKS.
GUTTERS, PIPES, &c.

BRABY for Iron and **STEEL**
ROOFS and BUILDINGS.

BRABY for unbreakable **STEEL**
SASHES, CASEMENTS, and
PUTTYLESS ROOFLIGHTS.

BRABY for galvanized corrugated **STEEL**
SHEETS: "EMPRESS" & "SUN" BRANDS

FREDERICK BRABY & Co. Ltd., Eclipse Iron & Galvanising Works & Steel Sheet Rolling Mills, Petershill Road, GLASGOW.

Show Rooms and Aluminium Warehouse, 124, St. Vincent Street, Glasgow.
Rustless Iron, Galvanising and Copper Works, FALKIRK.

Also at London, Deptford, Liverpool, Bristol, Belfast and Dublin. CONTRACTORS to BRITISH and FOREIGN GOVERNMENTS. Teleg.—"Braby, Glasgow."

ELDERS FOUNDRY COKE

AS SUPPLIED TO THE
BRITISH
ADMIRALTY DOCKYARDS

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blowholes and other defects, than we formerly did.

From BOW, McLACHLAN & CO., LTD. (Paisley Foundry), Paisley, Glasgow.

Paisley, 12th March, 1909.

We have yours of 4th inst., and in reply have pleasure in stating that we have been using your Foundry Coke for several years for special purposes with highly satisfactory results.

Elders Collieries, Ltd., Cardiff.

FIRE BRICKS & CLAY

CUPOLA BRICKS.
BEST QUALITY.

LESSEES OF DELPH AND TINTERN ABBEY BLACK AND WHITE CLAY.

KING BROTHERS,
(STOURBRIDGE) Ltd.,
STOURBRIDGE.

JOHN HALL & CO.

OF STOURBRIDGE, LIMITED,
STOURBRIDGE, ENGLAND.

Manufacturers of
FIRE BRICKS, BLAST FURNACE BRICKS AND CUPOLA BRICKS.

A REVOLUTION IN THE FOUNDRY.

THERE IS NOTHING LIKE IT.

Proved by the leading firms to be absolutely reliable and holds an impregnable position in the foundry after all others have failed

"SPERMOLIN" (Regd).

Is used by all the leading firms in the making of Cores of Castings for Steam Engines, Turbines, Gas and Oil Engines, Motor Car Cylinders, Pumps of all descriptions, Machine Tools, Radiators, Sectional Boilers, Gas Stoves and Gas Rings, Malleable Iron Castings, Steel, Iron and Aluminium Castings.

FOR FURTHER PARTICULARS WRITE TO:—

The SPERMOLIN Core Co., George Square, HALIFAX.

Or to:— **HALL AND GILLAM, EXCHANGE BUILDINGS, BIRMINGHAM.**

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years:—

Metals.	End July, 1913.	End July, 1912.
Iron—Scotch pig warrants ton	..... *64/-	..... *61/10½
—Middlesbro' warrants ... ton	..... 55 0	..... 59 4
—W.C. M/nos Bessemer ... ton	..... 76 6	..... 77/6
—Stock, Middlesbrough ...tons	 191,301	 192,299
Copper—Chili bars GMB ton	..... £67 5 0	..... £78 2 6
—Stock, Europe and afloat tons	..... —	..... —
Tin—English ingots ... ton	..... £187 0 0	..... £210 0 0
—Straits ... ... ton	..... £182 5 0	..... £204 15 0
—Stock, London, Holland, U.S.A., and afloat ...tons	 13,713	..... —
Lead—English pig ... ton	..... £21 7 6	..... £19 7 6
Spelter—Ord. Silesian ... ton	..... £20 12 6	..... £26 0 0
Quicksilver (75lb)... bottle	..... £7 5 0	..... £8 10 0
Antimony—Regulus ... ton	£23 10 0 £31 10 0	£27 10 0 £28 10 0
Aluminium—Ingot ... ton	£86 0 0 £88 0 0	..... £80 0 0

*Settlement price.

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings:—

	£ s. d.		£ s. d.
Columns (plain)	7 7 6	to	7 12 6
Pipes, 1¼ to 2½ in.	6 12 6	to	7 0 0
,, 3 to 4 in.	6 5 0	to	6 7 6
,, 5 to 8 in.	6 0 0	to	6 2 6
,, 10 to 16 in.	6 2 6	to	—
,, 18 to 24 in.	6 2 6	to	—
Chairs	4 14 0	to	4 15 0
Floor plates (open sand)	3 10 0	to	3 12 6

SCRAP.

The quotations for scrap, subject to market fluctuations, are as follows: Heavy wrought (mixed), £2 17s. 6d.; light wrought, £1 5s. 0d.; heavy cast, £3 3s. 6d.; all per ton, f.o.b., London. Copper (clean), £64 10s. 0d.; brass (clean), £43 0s. 0d.; lead (usual draft), £19 5s. 0d.; Zinc, £16 10s. 0d.; all per ton delivered merchant's yards.

Personal.

Mr. F. W. Cockshott has been appointed an inspector of factories and workshops.

The late Mr. William Brierley, brassfounder, Drake Street, Rochdale, left net personalty valued at £40,231.

The late Mr. Edgar Musgrave, a director of Musgrave and Company, Limited, left estate valued at £65,974 gross.

Mr. J. W. Peace is retiring from the position of Sheffield secretary to the Royal Metal Trades Pension Society, after 38 years' service.

Mr. H. F. Flannery has been elected a director of Flannery, Baggallay & Johnson, Limited, consulting engineers, of London and Liverpool.

The late Mr. Joseph Bates, of Wrottesley Road, Tettenhall, brassfounder, lock and iron safe maker and nickel-plater, left estate of the gross value of £52,963.

Professor D. A. Low has had the distinction of "Emeritus Professor of Engineering" conferred upon him by the governing body of the East London College.

Personal estate in the United Kingdom to the value of £4,467 has been left by the late Mr. R. Cassels, a director of the Steel Company of Scotland, Limited, and of the Vogt Engines, Limited.

Mr. G. Mure Ritchie, one of the directors of Palmers Shipbuilding and Iron Company, Limited, Jarrow, and Palmers Hebburn Company, Limited, Hebburn, has been elected chairman of the former company in succession to the late Lord Furness. Mr. C. G. Bryan has been elected a director of Palmers Company to fill the vacancy caused by the death of Admiral Sir Archibald Douglas.

BLOFIL
THE
IRON CEMENT
(Quick or slow setting grades)
IS
THE CHEAPEST
AND
MOST RELIABLE
for all purposes.
Unaffected by oil, steam, or water.

Sole manufacturers—

RUDD & OWEN
(DEPT. I)
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Telegrams "Theripnene," Hull.
Telephone National 1223.

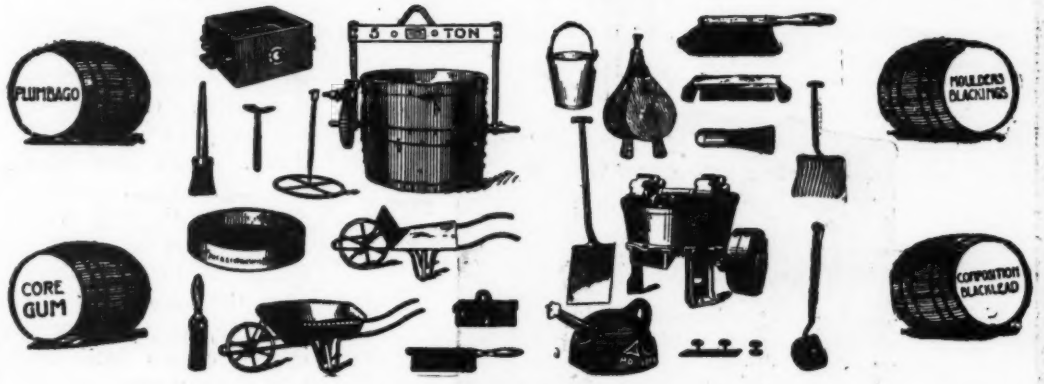
GANISTER, CUPOLA BLOCKS, FIRE BRICKS,
FIRE CLAY.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & Co., Ltd.,
DEEPCAR, nr. SHEFFIELD.
Telegrams: "LOWOOD, DEEPCAR."

Established 1863.

JAS. DURRANS & SONS,

Phœnix Works, Penistone, Near Sheffield.



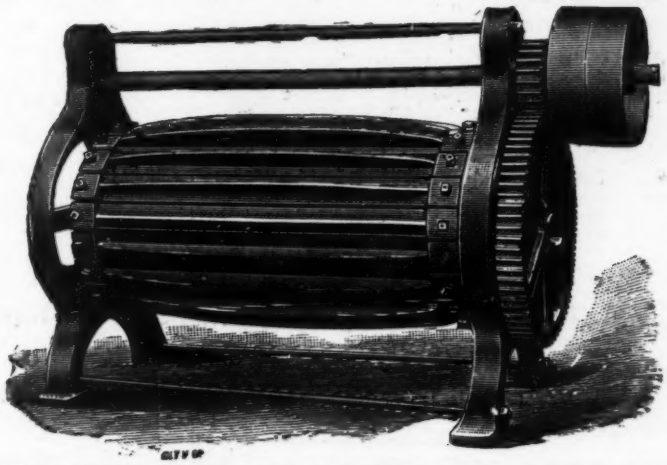
Manufacturers of all

FOUNDRY EQUIPMENTS

COMPOSITION BLACK LEAD, PLUMBAGO, CORE GUM, WHITE DUST & COAL DUST

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

Improved Foundry Rattler or Fettling Drum.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

The following testimonial explains itself :—

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD.

The "Tottenham" Portable Hot-Air Core Oven.

The Oven is built on a Scientific principle which causes a rapid circulation of hot dry air to pass round the cores. They are dried thoroughly right through; those on the top shelf being dried as quickly as those below. Burning the cores is impossible, as no flame or smoke comes into contact with them.

It is arranged for fuel or gas and is exceedingly economical in the consumption of either.

Call and see it.

THE "BUESS" OIL-FIRED CRUCIBLE MELTING FURNACE IS WITHOUT A RIVAL. THERE IS NO OTHER TO COMPARE WITH IT FOR ECONOMICAL WORKING AND SIMPLICITY OF OPERATION.

With our 15 different Types of Moulding Machines we cover the requirements of any foundry. Call and see them at work.

EMERY GRINDERS. ABRASIVE WHEELS.

THE LONDON EMERY WORKS Co., PARK WORKS,

TOTTENHAM, LONDON, N.

Passenger Station, Park G.E. Rly. Telephone: Tottenham, 158.

THE BUYER'S GUIDE

Addresses and further information will be found by reference to the Firm's Advertisement.

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London Emery Works.
Murphy, Stedman & Co., Ltd.

Air Compressors.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.
Thwaites Bros., Ltd.
Tilghman's Patent Sand Blast Co., Ltd.

Air Compressors (Electrically Driven).
Marshall & Co., Horace P.
Tilghman's Patent Sand Blast Co., Ltd.

Air Compressors (Steam).
Marshall & Co., Horace P.
Tilghman's Patent Sand Blast Co., Ltd.

Air Compressors (Belt).
Marshall & Co., Horace P.
Tilghman's Patent Sand Blast Co., Ltd.

Aluminium.
British Aluminium Co., Ltd.

Annealing.
Evans, J., & Co.
Phillips, J. W. & C. J.

Ash Crushing and Washing Machines.
Evans, J., & Co.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.

Barrels (Tumbling).
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Evans, J., & Co.
Durrans, Jas., & Sons.
Hall, Charles, & Co.
Olsen, Wm.

Blacklead.
Durrans, J., & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Olsen, Wm.
Walker, I. & I
Wilkinson & Co., Thos., Ltd.

Blowers.
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Davis, T., & Son.
Dempster, R. & J., Ltd.
Evans, J., & Co.
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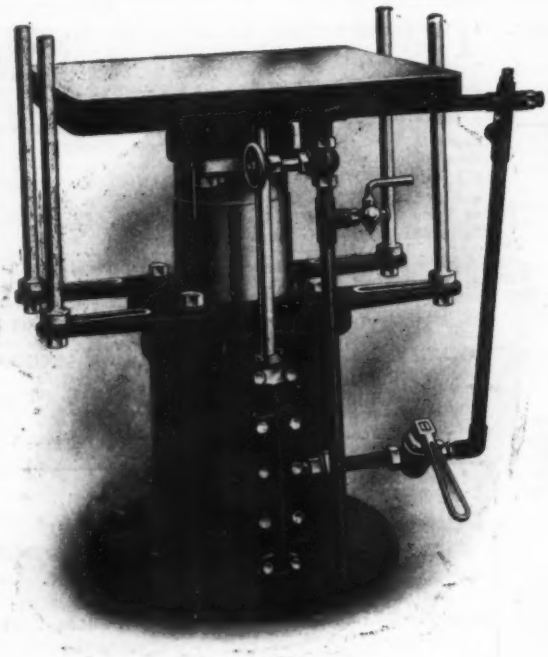

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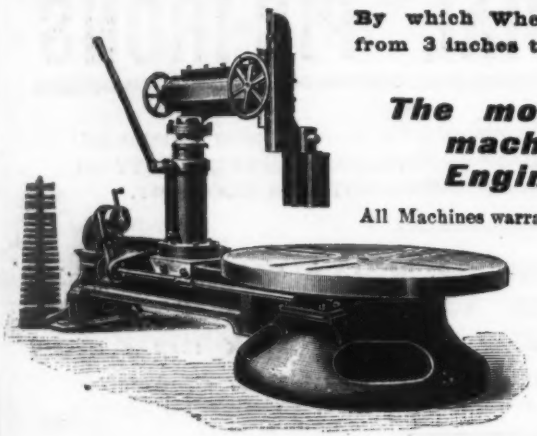

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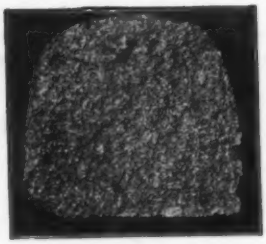
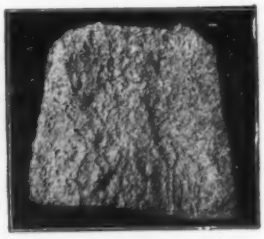
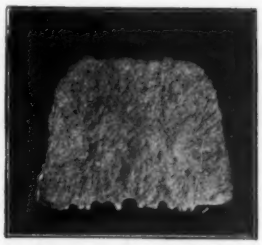

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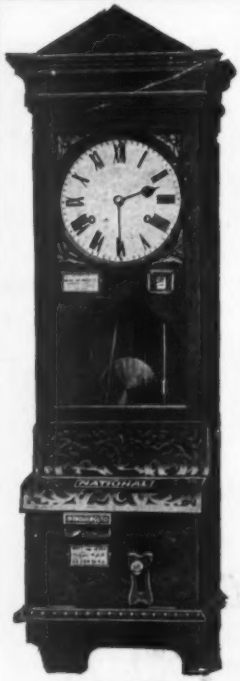

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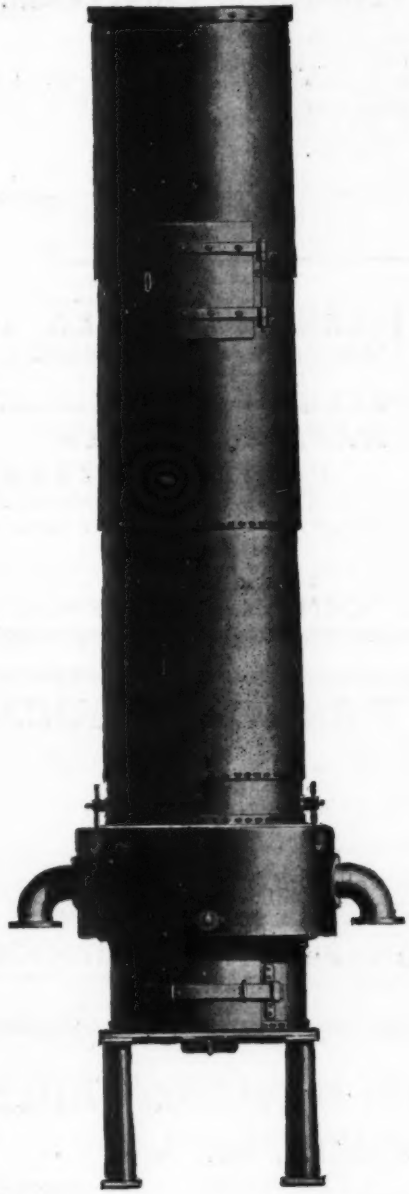

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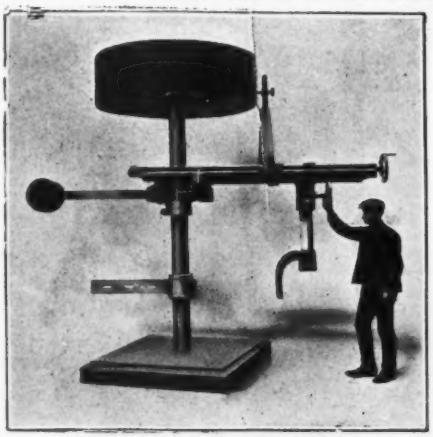

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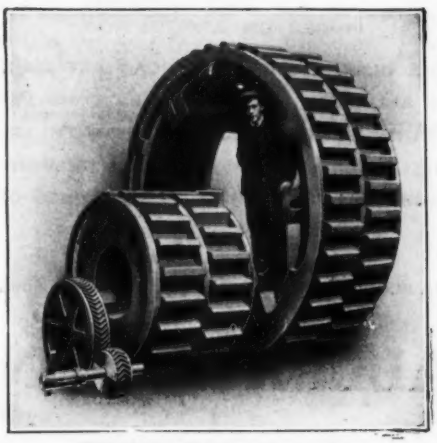

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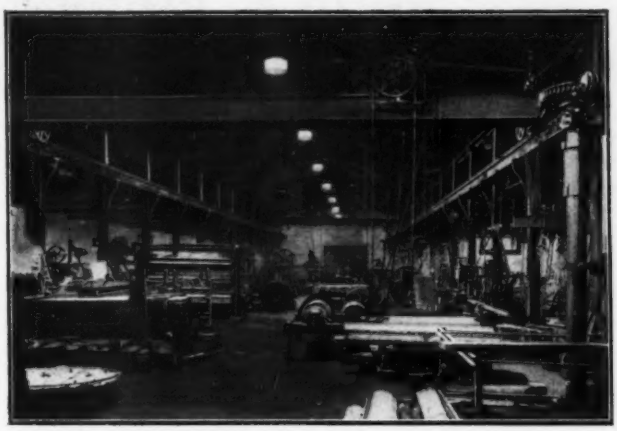

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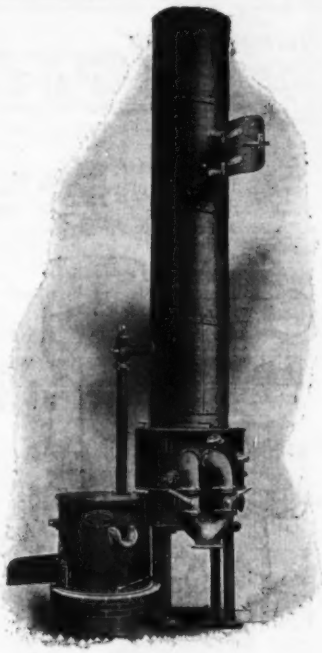

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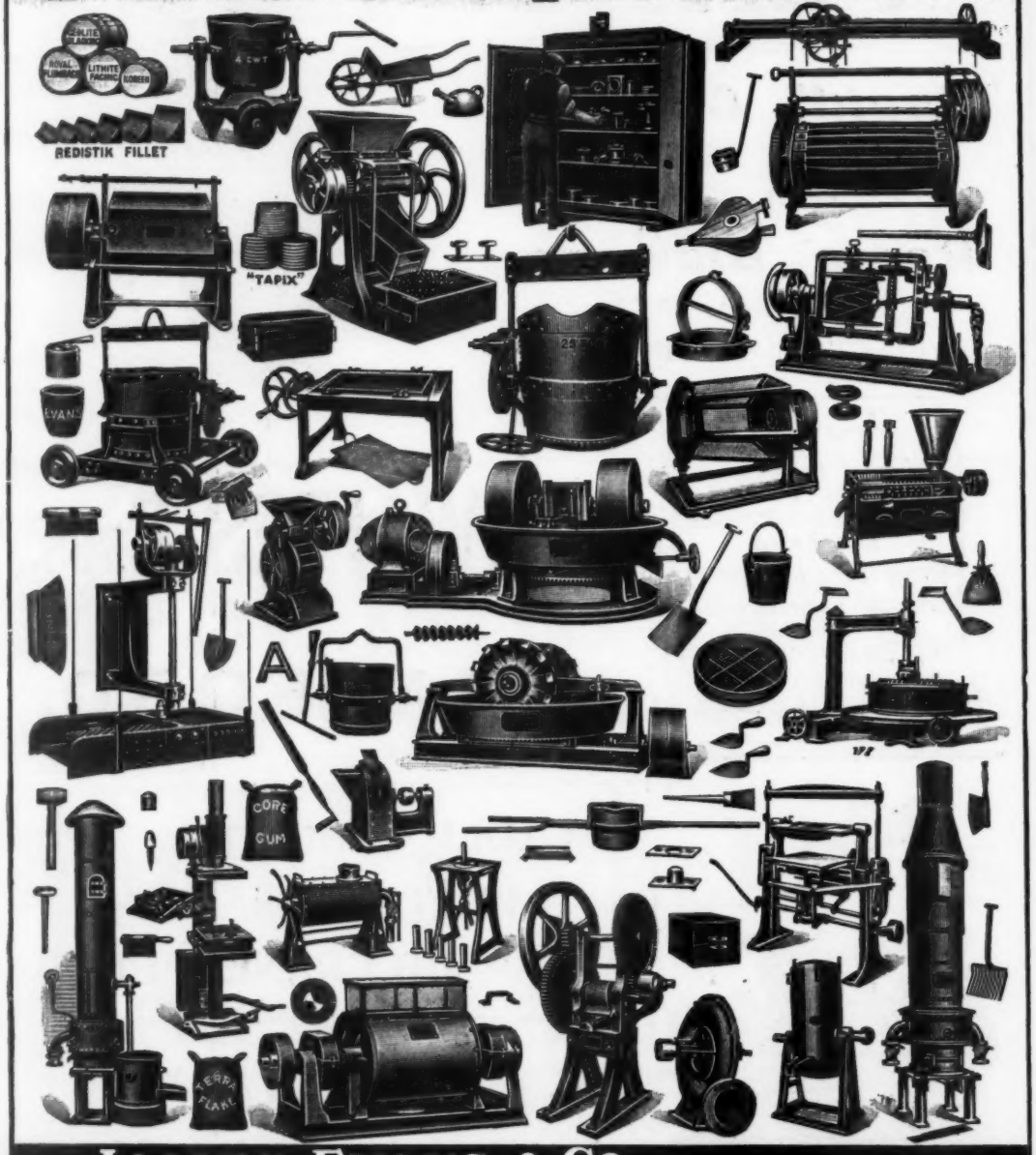

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